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Final
Preliminary OE/MEC Site Investigation Work Plan for Blue Beach and Red Beach
Eastern Maneuver Area
Vieques Island, Puerto Rico

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Under the
LANTDIV CLEAN II Program
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Prepared by

CH2MHILL

Tampa, Florida

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List of Acronyms

AEDA	Ammunition, Explosives and Dangerous Articles
AFWTF	Atlantic Fleet Weapons Training Facility
AR	Army Regulation
ARAR	Applicable or Relevant and Appropriate Requirement
ATF	Bureau of Alcohol, Tobacco and Firearms
ATV	All-terrain-vehicle
BD	Base Detonating
BRAC	Base realignment and closure
CAP	Corrective Action Plan
CAR	Corrective Action Request
CCLI	Commerce Control List Items
CDC	Centers for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFA	Controlled Firing Area
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CLEAN	Comprehensive Long-Term Environmental Action Navy
cm	Centimeters
CNS	Central nervous system
CPR	Cardio-pulmonary resuscitation
CTO	Contract task order
CWM	Chemical warfare material
DA	Department of the Army
DA Pam	Department of the Army Pamphlet
DDESB	DoD Explosive Safety Board
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DOI	Department of the Interior
DOT	U.S. Department of Transportation
DQO	Data Quality Objective
EM	Engineering Manual
EMA	Eastern Maneuver Area
EOD	Explosive Ordnance Disposal
EPA	Environmental Pollution Agency
EZ	Exclusion zone
FAA	Federal Aviation Administration
ft	Foot / feet
FUDS	Formerly Used Defense Sites
FWS	Fish & Wildlife Service
GFCI	Ground fault circuit interrupter
GIS	Geographical information system

GPS	Global positioning system
HEPA	High-efficiency
HH	Hand-held
HR	Heart rate
HSM	Health and Safety Manager
HTRW	Hazardous, toxic, or radioactive waste
IDW	Investigation-derived waste
IR	Installation restoration
LANTDIV	Atlantic Division
LIA	Live Impact Area
m	Meter
MEC	Munitions and explosives of concern
MLI	Munitions List Items
mm	Millimeter
mph	Miles per hour
MPM	Most Probable Munition
MSDS	Material Safety Data Sheet
msl	Mean sea level
mV	Millivolts
NAD	North American Datum
NASD	Naval Ammunition Support Detachment
NAVFACENGCOM	Naval Facilities Engineering Command
NOSSA	Naval Ordnance Safety and Security Activity
NSC	National Safety Council
NSRR	Naval Station Roosevelt Roads
NTR	Navy Technical Representative
OB/OD	Open burn/open detonation
OE	Ordnance and explosives
OECERT	Ordnance Detection Sweep Efficiencies Guidance for Use in Ordnance and Explosives Cost Effectiveness Tool
ORS	OE-related scrap
OSHA	Occupational Safety and Health Act
PDF	Adobe Acrobat Document Format
PDS	Personnel Decontamination Stations
PFD	Personal flotation device
PPE	Personal Protective Equipment
PRA	Preliminary Range Assessment
PZ	Piezoelectric fuzing
QC	Quality Control
QCP	Quality Control Plan
RAC	Risk Assessment Code
RMSF	Rocky Mountain spotted fever
RPM	Remedial Project Manager
SDS	Spatial Data Standards
SHSO	Site Health and Safety Officer
SIA	Surface Impact Area
SOP	Standard of Practice

SSC	Site Safety Coordinator
SSHP	Site Safety and Health Plan
SUXOS	Senior UXO Supervisor
TDEM	Time-Domain Electromagnetic
TEU	Technical Escort Unit
TSDF	Treatment, storage, and disposal facility
TSSD	Tri-Spatial Data Standard
ttn	Triangulated network
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Corps of Engineers Engineering and Support Center
UXO	Unexploded ordnance
UXOSO	UXO Safety Officer
WP	White phosphorus
4WD	Four-wheel drive

SECTION 1

Introduction

This Preliminary Ordnance and Explosives (OE) Site Investigation Work Plan for Blue Beach and Red Beach has been prepared by CH2M HILL for the Naval Facilities Engineering Command (NAVFACENGCOM) Atlantic Division (LANTDIV) under Navy Contract N62470-95-D-6007, Navy Comprehensive Long-Term Environmental Action Navy (CLEAN), District III, Contract Task Order 272 to meet the current DoD requirements for investigation of munitions and explosives of concern (MEC). This Work Plan addresses response actions to be taken that minimize risks to human health and the environment from potential exposure to MEC that may have resulted from past Department of Defense (DoD) activities at the two beaches located on the southern coast of the Eastern Maneuver Area (EMA) on the eastern end of Vieques Island, Puerto Rico.

This Work Plan presents site-specific information related to Blue Beach and Red Beach and is designed to supplement the Final OE Master Work Plan developed for the Former Naval Ammunition Support Detachment (NASD) on the western side of Vieques (CH2M HILL, October 2001). The OE Master Work Plan provides the background information needed to understand OE/MEC site conditions, the approach to be used for investigations, and general types of activities to be accomplished at OE/MEC sites. Only supporting documentation relating to Blue and Red Beaches, including additions/deviations from the OE Master Work Plan, are presented within this document. The organization of this work plan is summarized below.

Section 2, Technical Management and MEC Support Plan—Identifies the approach, methods, and operational procedures to be employed during OE/MEC investigation and recovery activities. Specific procedures for certain tasks are included by reference to the appropriate sub-plan of this Work Plan.

Section 3, Geophysical Investigation Plan—Describes the approach, methods, and operational procedures employed to perform geophysical mapping during investigation activities.

Section 4, CH2M HILL Site Safety and Health Plan—Describes the Safety and Health Program and presents safety and health information and requirements during investigation activities.

Section 5, Location Surveys and Mapping Plan—Describes the methods, equipment and accuracy requirements for location surveys and mapping in support of investigation activities.

Section 6, Quality Control Plan—Describes the approach, methods, and operational procedures to be used for the performance of quality control during investigation activities.

Section 7, Environmental Protection Plan—Presents the approach, methods, and operation procedures to be implemented to protect the natural environment during investigation activities.

Section 8, Geographical Information System Plan—Describes the requirements for the geographical information system (GIS) to be utilized during investigation activities.

Section 9, References—Lists documents cited in this Work Plan.

A records search is being completed as part of the planned Preliminary Range Assessment (PRA) for Eastern Vieques, which includes the EMA and the Surface Impact Area (SIA), to accumulate repository information related to MEC and MEC areas within Eastern Vieques. Results of the records search may provide additional site specific information related to Blue Beach and Red Beach that will enhance the OE/MEC investigation at the two beaches. Any site-specific information gathered from the records search will be presented in the final report for this assignment.

1.1 Background

The U.S. Navy's presence on the eastern end of Vieques will come to a close on May 1, 2003, as Naval operations at the facility cease in accordance with current legislation (Public Law 106-398 – Appendix). The current legislation calls for the property on the eastern end of Vieques to be transferred to the Department of the Interior (DOI) and to be managed as a federal wildlife refuge by the U.S. Fish & Wildlife Service (FWS). The Live Impact Area (LIA) will be transferred to the DOI and managed as a wilderness area with no public access.

A summary of the history and background of Naval operations on Eastern Vieques is currently being developed in the *Draft Site Management Plan* for the eastern end of Vieques. This plan will be provided to the field teams for their use in reconnaissance efforts. The *Draft Site Management Plan* provides range utilization records, quantities of ordnance and dates of use, and descriptions of the two facilities.

1.2 Work Plan Purpose and Objective

The purpose of this Work Plan is to describe the general approach and methods, including the operational and safety procedures, to be used by CH2M HILL and its subcontractors to perform OE/MEC response actions at the Blue Beach and Red Beach areas at the EMA. The objective of this contract task order (CTO) is to conduct a preliminary OE/MEC investigation at Blue Beach and Red Beach to assess whether these areas contain OE/MEC. This Work Plan provides the framework and basic guidance for the performance of OE/MEC site investigations, evaluations, and responses as required to allow the sites potentially affected by OE/MEC to be used safely and effectively for their intended purpose. The intended land use of Blue Beach and Red Beach is public recreation. Once the beaches have been cleared and re-opened for recreational use, they will no longer be used for military operations involving any type of ordnance.

This OE/MEC investigation will be executed in accordance with OPNAVINST 8020.14, Department of the Navy Explosives Safety Policy, NAVSEA OP 5 Volume 1, Ammunition and Explosives Ashore, U.S. Army Engineering and Support Center, Huntsville IGD 00-003, *Basic Safety Concepts and Considerations for Ordnance and Explosive Operations*. The OE/MEC response action will also be in compliance with Title 40, Code of Federal Regulations,

Part 260 (40 CFR 260), et al. – *Military Munitions Rule*; the OE requirements of DoD 6055.9-STD; and any other applicable publications listed in Table 1-1 that may apply to this project. Section 2.1.1 of this Work Plan lists and provides details on guidance documents, regulations, and policies listed in Table 1-1 that are most applicable to this assignment.

TABLE 1-1
Potentially Applicable or Relevant and Appropriate Requirements and To Be Considered

Reference	Title
	Federal Requirements
29 CFR Part 1910	Occupational Safety and Health Standards
29 CFR Part, Subpart T, 1910.401	Commercial Diving Operations
29 CFR Part 1926	Safety and Health Regulations for Construction
40 CFR Part 300	National Oil and Hazardous Substances Pollution Contingency Plan (CERCLA Process*)
40 CFR Parts 260-279	Hazardous Waste Management (RCRA ARARs)**
40 CFR Parts 355, 370, and 372	Emergency Planning & Community Right-to-Know (Inventories and Release Reporting)
40 CFR Parts 50-73	Clean Air Act (Release Limits)
49 CFR Parts 100-199	Department of Transportation (Truck Transportation on Public Roads)
Bureau of Alcohol, Tobacco and Firearms 5400.7	Laws and Regulations for Explosives (Control of Explosives)
	Department of Defense (DoD)
DoD 4160.21-M	Defense Reutilization and Marketing Manual
DoD 4160.21-M-1	Defense Demilitarization Manual
DoD 4715.11	Environmental and Explosives Safety Management on Department of Defense Active and Inactive Ranges Within the United States
DoD 4715.12	Environmental and Explosives Safety Management on Department of Defense Active and Inactive Ranges Located Outside the United States
DoD 6055.9-STD	Ammunition and Explosives Safety Standards
	U.S. Army Corps of Engineers
EM 385-1-1	Safety and Health Requirements Manual
EP 75-1-2	Unexploded Ordnance Support for Hazardous, Toxic and radioactive Waste and Construction Support Activities
EP 1110-1-17	Establishing a Temporary Open Burn/ Open detonation Site for Conventional OE Projects
EP 1110-1-18	OE Response
EP 1110-3-8	Public Participation in the Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS)
ER 385-1-92	Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste and Ordnance and Explosive Activities

TABLE 1-1
Potentially Applicable or Relevant and Appropriate Requirements and To Be Considered

Reference	Title
ER 1110-1-12	Quality Management
ETL 1110-1-165	Procedures for Conducting Preliminary Assessments at Potential Ordnance Response Sites
ETL 1110-1-166	Procedural Document for Archive Search Reports
ETL 1110-1-168	Procedures for Establishing and Maintaining an Administrative Record
ETL 1110-1-169	Procedures for Establishing and Maintaining a Restoration Advisory Board
ETL 1110-1-170	Public Involvement Plan for OE Response
ER 1110-1-8153	Engineering and Design Ordnance Explosives Response
ER 1110-1-8158	Corps Wide centers of Expertise Program
U.S. Army Corps of Engineers Engineering and Support Center, Huntsville (USACESCH)	
ETL 385-1-1	Safety Concepts and Basic Considerations for Unexploded Ordnance Operations (Revised February 16, 1996)
CEHND 1115-3-524	Removal Action Planning for OE Sites Procedural Document
Memorandum, CEHND-PM-MC, dated August 10, 1994	Procedures for Establishment of Anomaly Review Boards
CX GD 97-01	Ordnance Detection Sweep Efficiencies Guidance for Use in OE Cost Effectiveness Tool (OECERT)
CX GD 97-08	Contracting of Ordnance Explosives Response Projects
IGD 98-01	Transfer of Ordnance Explosives Response Projects
IGD 98-02	Revised Risk Assessment Form for OE Sites
IGD 98-04	Reportable Material at Ordnance Explosives Response Sites
IGD 98-05	Contents of Explosives Safety Submission for Removal of Ordnance Explosives from Real Property
IGD 98-08	Determination of Appropriate Safety Distances on Ordnance Explosives Project Sites
IGD 98-10	Conventional OE Removal Actions
IGD 99-01	Unexploded Ordnance (UXO) Support for Other Activities
IGD 99-02	Small Arms Determination
IGD 99-03	Updated Risk Assessment Code (RAC) Worksheet
MOA	U.S. Army 52nd Ordnance Group and U.S. Army Engineering and Support Center, Huntsville
U.S. Navy	
NAVSEA OP 5 Vol 1	Ammunition and Explosives Ashore: Safety Regulations for Handling, Storing, Production, Renovation, and Shipping
NAVSEA OP 2165	Navy Transportation Safety Handbook for Ammunition, Explosives, and Related Hazardous Materials

TABLE 1-1
Potentially Applicable or Relevant and Appropriate Requirements and To Be Considered

Reference	Title
NAVSEA OP 2239	Motor Vehicle Driver's Handbook, Ammunition, Explosives, and Related Hazardous Materials
NAVSEA 4570.1	Demilitarization and Disposal of Excess, Surplus, and Foreign Excess Ammunition, Explosives and Other Dangerous Articles and Inert Ordnance Material
NAVSEA 8020.9	Non-Nuclear OE Handling Qualification and Certification Program
OPNAVINST 5090.1	Environmental and Natural Resources Protection Manual
OPNAVINST 5102.1C	Mishap Investigation and Reporting
OPNAVINST 5530.13	Department of the Navy Physical Security Instruction for Sensitive Conventional Arms, Ammunition and Explosives
OPNAVINST 8020.14	Department of the Navy Explosives Safety Policy
OPNAVINST 8023.2	U.S. Navy Explosives Safety Policies, Requirements, and Procedures
OPNAVINST 8026.2A	Navy Munitions Disposition Policy
SS521-AG-PRO-010	U.S. Navy Diving Manual
SWO60-AA-MMA-010	Demolition Materials Protection
Environmental Pollution Agency (EPA)	
Title 126	Hazardous Waste Regulations**
Title 126	Emergency Planning & Community Right-to-Know and Contingency Planning Regulations (Reporting Requirements)
Title 129	Air Quality Regulations (Release Limits)

Notes:
CFR = Code of Federal Regulations
RCRA = Resource Conservation and Recovery Act
* Comprehensive Environmental Response, Compensation, and Liability Act of 1980
** denotes substantive requirements of this regulation only

1.3 Eastern Vieques Description

1.3.1 Location and Mission

Vieques Island has a land area of approximately 33,000 acres, and is located in the Caribbean Sea approximately 7 miles southeast of the eastern coast of the island of Puerto Rico (Figure 1-1). The Navy's facilities are located on the eastern one-third of the island. For the purposes of this Work Plan, the Facility includes the SIA, the LIA, and the Eastern Conservation Area (collectively comprised of 3,600 acres) and the adjacent and wholly contiguous EMA, comprised of 11,000 acres. Both are under the command of Naval Station Roosevelt Roads (NSRR).

AFWTF - Altantic Fleet Weapons Training Facility
EMA - Eastern Maneuver Area
Former NASD - Former Naval Ammunition Storage Detachment

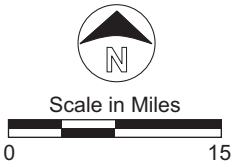

Figure 1-1
SITE LOCATION MAP
Vieques Island, Puerto Rico

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1.3.2 Structures, Roads, and Other Site Improvements

The two beach sites, illustrated on Figures 1-2 and 1-3, are accessed by a series of unfinished dirt roads that run north from the Camp Garcia area. No structures or other site improvements are evident at the two sites, based on review of a series of historical aerial photographs. Any structures or site improvements noted during implementation of field activities will be described in the report associated with this preliminary OE investigation.

1.3.3 Land Use

In general, the Eastern Vieques land area (14,600 acres) remains largely undeveloped. The Navy land use, primarily for military training and those support services associated with the training, comprises only a fraction of these land areas. Future land use is expected to change with the Navy's planned departure in May 2003. Current legislation calls for the EMA to be turned over to the DOI at that time, after which it will be operated as a wildlife refuge.

1.3.4 Climate

The climate of Vieques is characterized as warm and humid (tropical-marine), with frequent showers occurring throughout the year. The temperature on Vieques is moderated by the easterly trade winds blowing across the island year-round, resulting in a mean annual temperature of 79°F to 80°F and a daily variation of 15°F to 25°F. The average rainfall is approximately 36 inches, with extremes of 25 inches in the east and 45 to 50 inches in the west (A.T. Kearney, Inc., October 1988).

1.3.5 Topography

The topography of Vieques consists generally of hills and valleys throughout the entire island. The western side of the island consists of gently rolling hills with a deeper soil profile than the eastern side, which is more exposed rugged terrain. The highest point on the western side is approximately 1,000 feet (ft) above mean sea level (msl) at Monte Pirata. The highest point on the eastern side is approximately 420 ft above msl at Cerro Matias. The coastal areas contain level terrain primarily made up of lagoons and mangrove swamps.

The site topography of the two study area beaches is relatively flat with gentle slopes southward toward the sea.

1.4 Eastern Vieques History

Eastern Vieques provides facilities and schedules naval gunfire support (NGFS) and air-to-ground (ATG) ordnance delivery training for Atlantic Fleet ships, NATO ships, air wings, and smaller air units from other allied nations and the Puerto Rican National Guard. The Fleet Marine Force, Atlantic, conducts training for Marine amphibious units, battalion landing teams and combat engineering units in the EMA. Occasionally, naval units of allied nations having a presence in the Caribbean. the Puerto Rican National Guard has also utilized the EMA in the past.

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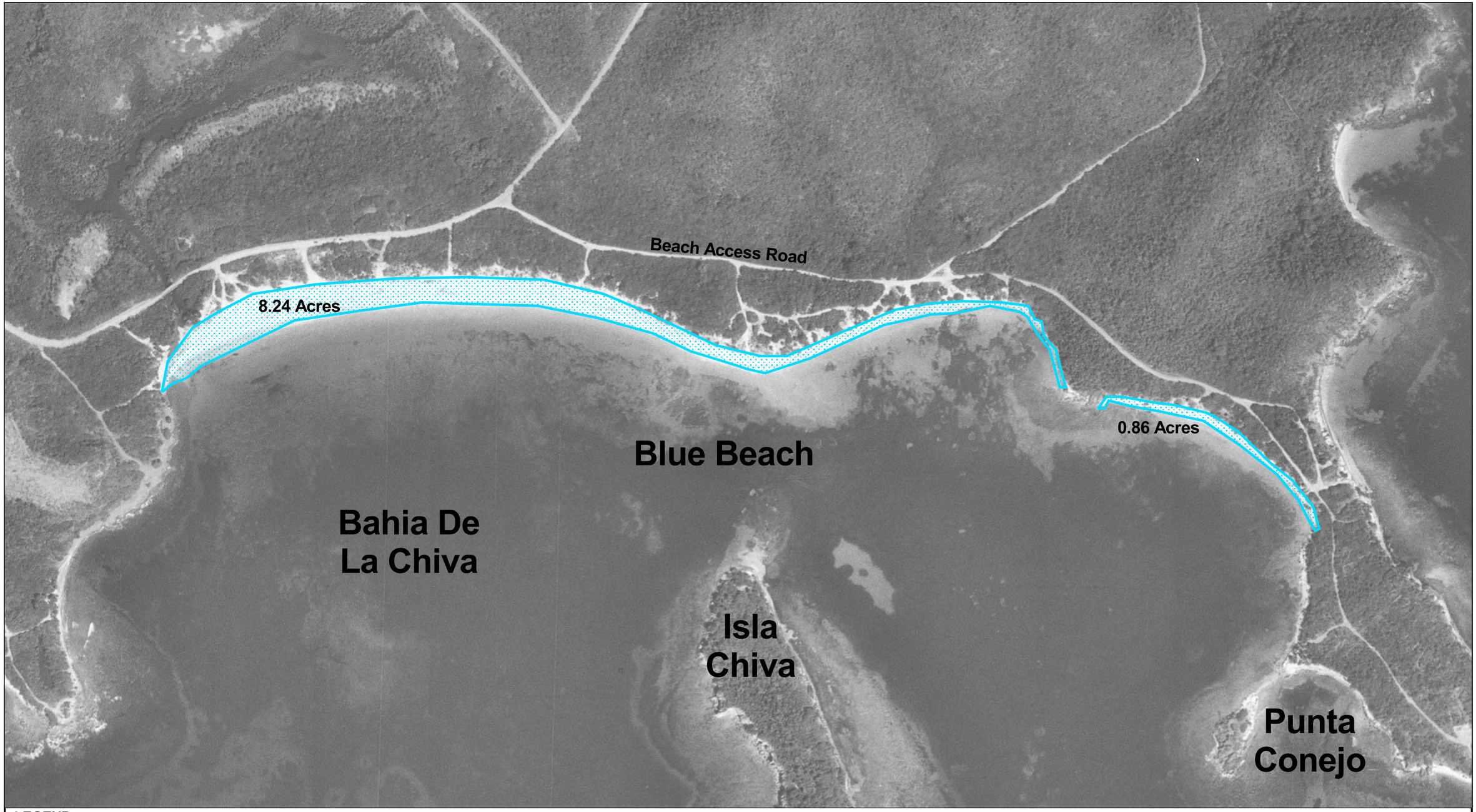

LEGEND

Approximate Limits of Preliminary OE Investigation

N

0 200 400 Feet

Figure 1-2
Map Illustrating Approximate Boundaries
of Preliminary OE Investigation
Blue Beach, Vieques Island, Puerto Rico

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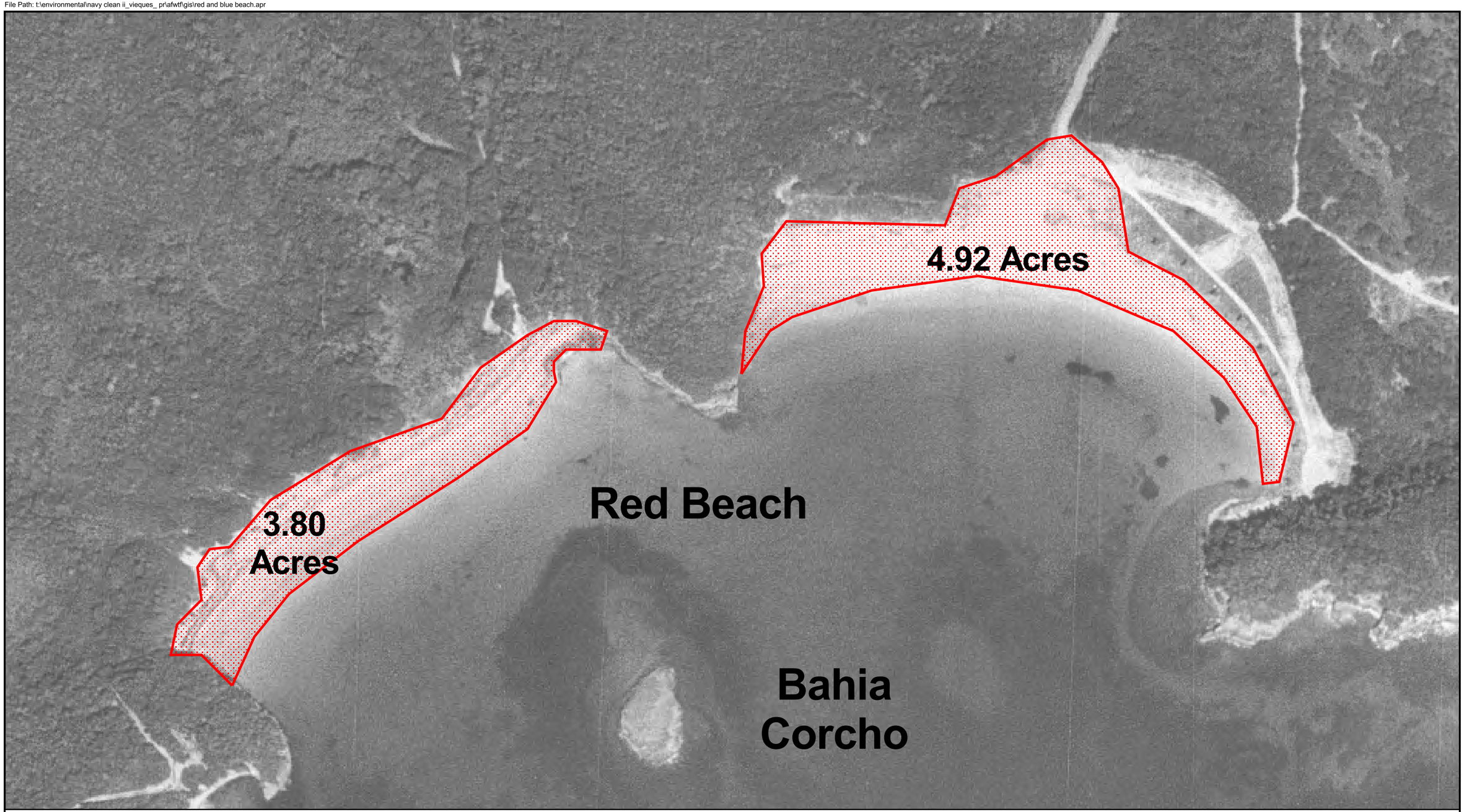

LEGEND

Approximate Limits of Preliminary OE Investigation

N

0 100 200 Feet

Figure 1-3
Map Illustrating Approximate Boundaries
of Preliminary OE Investigation
Red Beach, Vieques Island, Puerto Rico

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The training areas have been in continuous use since World War II when the Navy acquired title to the land. Within the Inner Range, the Atlantic Fleet's ships, aircraft and marine forces carry out training in all aspects of NGFS, ATG ordnance delivery, air-to-surface mine delivery, amphibious landings, small arms, artillery and tank fire, and combat engineering. As part of normal operations, MEC is cleared periodically from Eastern Vieques's Inner Range and destroyed by open detonation (OB/OD) at the Facility.

AFWTF operations have precluded outside development from occurring on the property and have resulted in the area remaining undeveloped. Before April 1999, public access to Red Beach and Blue Beach was allowed through Camp Garcia This practice has ceased temporarily since the April 1999 accident, in which a civilian employee was killed by an explosion from an errant ordnance item**.** The proposed future uses for the two sites include recreational uses similar to those prior to April 1999.

1.5 Previous Investigations

No previous environmental or OE/MEC investigations have been conducted at Blue Beach or Red Beach.

1.6 Work Plan Revisions

The draft work plan was reviewed by NOSSA. Responses to NOSSA's comments are included in Appendix A.

Changes to this Work Plan may be required during execution of OE/MEC response projects, primarily for two reasons:

1. The Navy project team may determine that a technical procedure needs to be added, deleted, or modified

2. CH2M HILL may propose a change as a result of observations made during the course of the project. CH2M HILL will request the changes, in writing, to the Navy Remedial Project Manager (RPM). Upon review and approval of the proposed change, CH2M HILL will issue updates to the Work Plan.

If the change to the Work Plan involves the discovery and/or disposition of MEC, then Naval Ordnance Safety and Security Activity (NOSSA) will be notified via e-mail. NOSSA is part of the CERCLA Technical Team and will be updated appropriately throughout the project.

To easily determine whether a Work Plan copy has been updated, a footer has been included on all pages, reflecting the date of the page and whether the page is part of the original plan (Revision 0), or a subsequent numbered revision. An updated list of numbered revisions will be included as Appendix B. As revisions occur, copies of the revised pages or plan will be distributed along with an updated Appendix B to appropriate personnel.

SECTION 2

Technical Management Plan

2.1 General

This Technical Management Plan identifies the approach, methods, and operational procedures to be employed to perform a Preliminary OE/MEC Site Investigation of Blue Beach and Red Beach at the EMA on Vieques Island, Puerto Rico. This plan was developed in accordance with OPNAVINST 8020.14, *Department of the Navy Explosives Safety Program,* and NAVSEA OP 5 Volume 1, *Ammunition and Explosives Ashore: Safety Regulations for Handling, Storing, Production, Renovation, and Shipping.*

The purpose of the Preliminary OE/MEC Site Investigation of Blue Beach and Red Beach is to conduct a digital geophysical survey of the open beaches and beach access roads to determine whether OE/MEC is present and to establish a documented defensible record of the findings. Surface avoidance surveys, geophysical data collection and reacquisition, and OE/MEC recovery will be completed with oversight by a Navy Explosive Ordnance Disposal (EOD) team from NSRR. If OE/MEC is encountered, it will be recovered by the Unexploded Ordnance (UXO) field teams and accumulated for subsequent removal and disposition by the NSRR EOD team. The work will be conducted following procedures similar to those used during the Green Beach OE/MEC investigation completed in April 2001 on the western side of Vieques.

2.1.1 Guidance, Regulations, and Policy

The following OE/MEC guidance, regulations, and policies are applicable or potentially applicable during implementation of the Preliminary OE/MEC Site Investigation of Blue Beach and Red Beach.

DoD 6055.9-STD, Ammunition and Explosives Safety Standards. This is the primary DoD regulation that establishes uniform safety standards applicable to ammunition and explosives, to associated personnel and property, and to unrelated personnel and property exposed to the potential damaging effects of an accident involving ammunition and explosives. It is applicable for determining safety distances, explosives storage requirements, facility construction and siting (e.g., OB/OD, magazines), and quantity-distance requirements.

DoD 4160.21-M, Defense Materiel Disposition Manual, and DoD 4160.21-M-1, Defense Demilitarization and Trade Security Control Manual. DoD 4160.21-M implements the Federal Property Management Regulation and other laws and regulations applying to the disposition of excess, surplus, and foreign excess personal property. DoD 4160.21-M-1 contains specific guidance for property identified as Munitions List Items (MLI) and Commerce Control List Items (CCLI). The guidance is applicable for the demilitarization and disposal of OE-related scrap material.

DoD 4145.26-M, DoD Contractor's Safety Manual for Ammunition and Explosives. DoD 4145.26-M describes safety procedures for contractors working with ammunition and explosives, and includes chapters on manufacturing propellants, and hazardous component safety data statements. It provides sufficient information to enable the contractor to make appropriate and reliable decisions affecting his or her facility or operations.

NAVSEA OP 5 Volume 1, Ammunition and Explosives Ashore: Safety Regulations for Handling, Storing, Production, Renovation, and Shipping. These regulations prescribe information regarding conventional ammunition, ammunition components, explosives, and other hazardous materials, as well as the conditions for safe production, handling, storage, shipment, maintenance, and disposal of these materials at all Navy and Marine Corps activities. They are applicable to protecting the environment during all hazardous, toxic, or radioactive waste (HTRW) and OE/MEC actions.

OPNAVINST 5530.13, Department of the Navy Physical Security Instruction for Sensitive Conventional Arms, Ammunition, and Explosives. This instruction prescribes standards and criteria for the physical security of sensitive conventional arms, ammunition, and explosives in the custody of any Navy Component, or contractor and subcontractor. It is applicable for determining appropriate requirements for security of explosives when maintained onsite.

OPNAVINST 5090.1, Environmental and Natural Resources Protection Manual. This manual prescribes Navy policies, responsibilities, and procedures to protect and preserve the quality of the environment. It is applicable to protecting the environment during all HTRW and OE/MEC actions.

OPNAVINST 8020.14, Department of the Navy Explosives Safety Policy. This policy prescribes Department of the Navy safety policy for contractors handling ammunition and explosives at Department of the Navy facilities. It is applicable for OE/MEC-related projects.

USACE ER 385-1-92, Safety and Health Requirements for HTRW and OE Waste Activities. These requirements identify the safety and occupational health documents and procedures required to be developed and implemented by U.S. Army Corps of Engineers (USACE) elements and their contractors responsible for executing HTRW and OE/MEC activities. They are applicable during all HTRW and OE/MEC activities.

USACE ER 1110-1-263, Chemical Data Quality Management for Hazardous Waste Remedial Activities. This regulation prescribes responsibilities and procedures for planning and executing chemical data acquisition including sampling and analysis. It is applicable to all phases of all projects, including OE/MEC projects where environmental samples are collected for chemical analysis.

USACE EP 1110-1-17, Establishing a Temporary OB/OD Site for Conventional OE Projects. This document provides general guidance compiled from many different DoD and Department of the Army (DA) sources for establishing and utilizing a temporary OB/OD site for the destruction of small quantities of OE/MEC. It is applicable in the event that an OB or OD site is needed.

USACE EP 1110-1-18, Ordnance and Explosives Response. This guidance provides the procedures and process to be used to manage and execute all aspects of OE/MEC response actions. It is applicable to all phases of all OE/MEC projects.

USACE EP 75-1-2, Unexploded Ordnance Support for HTRW and Construction Support Activities. This policy provides USACE personnel with procedural guidance, technical specifications, personnel and training requirements, and health and safety criteria for MEC support during HTRW and construction support activities. It is applicable to all projects for which anomaly avoidance or construction support is necessary because of the potential presence of MEC onsite.

USAESCH MCX Interim Guidance Document 00-03, Basic Safety Concepts and Considerations for OE Operations. This document establishes the safe operating procedures for dealing with OE/MEC items on formerly used defense sites (FUDS), base realignment and closure (BRAC), and installation restoration (IR) projects. It is applicable for all OE/MEC related projects.

EOD MU2 Detachment Roosevelt Roads Instruction 3120.5A. Provides non-emergency and emergency demolition operations standard operating procedures for NSRR.

Bureau of Alcohol, Tobacco and Firearms (ATF) ATF P 5400.7, Explosives Law and Regulations. This document prescribes regulations for transportation and storage of explosive materials. It is applicable for determining appropriate requirements for transportation and storage of explosives when maintained onsite.

2.1.2 Chemical Warfare Material

Chemical warfare material (CWM) is not expected to be encountered at the site based on historical research and interviews with military personnel familiar with historical operations at the two beaches. In the event that CWM is encountered, however, the following standard procedures will be utilized:

- The project manager shall immediately notify the Commanding Officer of NSRR upon discovery of CWM.
- The discoverer will immediately notify the Senior UXO Technician.
- The Senior UXO Technician will immediately direct the work team to stop work and evacuate the site in an upwind direction. The initial exclusion zone for CWM is 450 ft upwind per FM-9-15.
- The Senior UXO Technician should note the location of the suspected CWM to help with its identification and relocation.
- The Senior UXO Technician will designate a minimum of two UXO-qualified individuals to position themselves upwind as far as possible to prevent unauthorized personnel from accidental exposure.
- The Senior UXO Technician will immediately notify the NSRR Navy EOD Team and the NSRR's OE/MEC Safety representative. The NSRR OE/MEC Safety representative and EOD Team will initiate notification of the nearest Technical Escort Unit (TEU).

- The Senior UXO Supervisor (SUXOS) will account for all field personnel and notify the CH2M HILL Project Manager.
- The SUXOS will ensure that the area is secured until properly relieved by active duty EOD personnel. The SUXOS will direct CH2M HILL personnel to support such personnel as appropriate.
- Before work can resume, the site plans will be reviewed for adequacy in consideration of this newly discovered hazard.

2.1.3 Procedures When MEC Cannot be Disposed or MEC is Unidentified

Incidental OE/MEC items identified and investigated at the two sites will be inspected by the UXO Technicians. Items that are safe to move will be relocated under the oversight of the NSRR Navy EOD personnel to a bermed or sandbagged area a safe distance from ongoing operations. No items will be moved unless positively identified and determined safe to move. The item(s) will be marked and reported to CH2M HILL and the NSRR Navy EOD Team for disposal. OE/MEC encountered that is deemed unsafe to move will be marked in place and operations will be moved to another location pending evaluation and disposal by the NSRR EOD team. All live and suspected live items will be inspected and identified by two UXO Technicians. If the item cannot be positively identified and determined to be inert and safe to move, it will be marked and reported.

If, during identification of OE/MEC, it becomes necessary to move or handle the item, non-essential personnel will withdraw to a safe distance.

Examples of when military EOD response is necessary include:

- Discovery of a suspected CWM item
- Discovery of a MEC that cannot be safely moved
- MEC that cannot be positively identified

EOD units are not available to operate as ordnance contractors or as OE/MEC scrap disposal contractors. EOD work force limitations and mission priorities dictate that this resource must be used wisely and sparingly and therefore special emphasis will be placed on communication and coordination efforts between CH2M HILL and the NSRR EOD team so that appropriate oversight schedules can be developed.

2.1.3.1 Project Personnel, Organization, Communication and Reporting

The CH2M HILL organization for this project is depicted graphically in Figure 2-1. The CH2M HILL Project Managers designated for the oversight of this CTO are Mr. Marty Clasen and Mr. Fernando Ferreira. Mr. Ferreira will also serve as the Site Manager during implementation of this assignment. Mr. Clasen and Mr. Ferreira will both have overall responsibility for such activities as technical support and oversight, budget and schedule review and tracking, review of invoices, personnel resources planning and allocation, and coordination.

The Navy Clean II Program Manager, Mr. Ray Tyler, has complete management authority and responsibility for all work performed under the Clean II contract. The Program Manager directs the program management organization as a central resource for management, continuity, and control of all Clean II program activities.

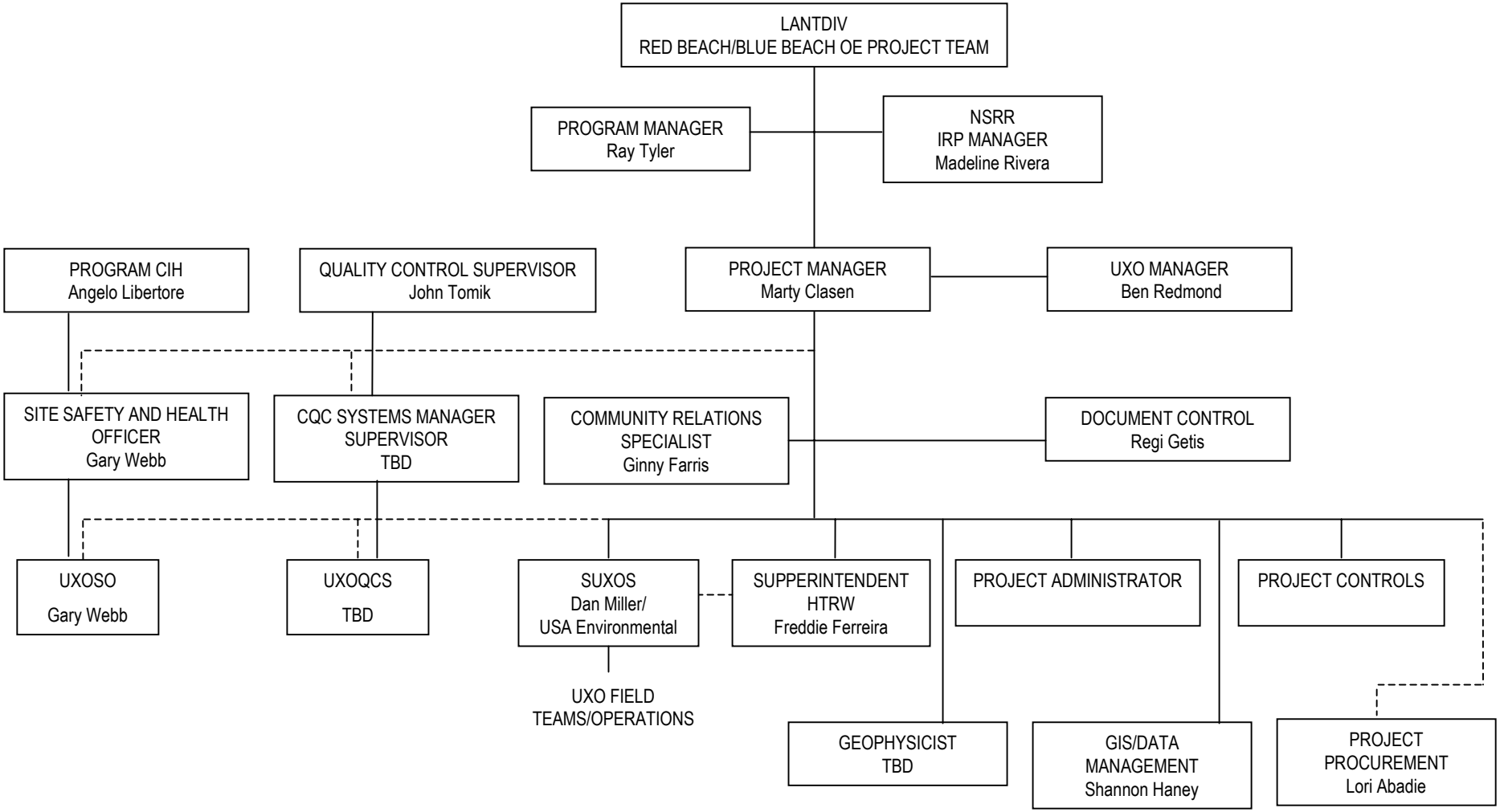

FIGURE 2-1
Project Organizational Chart
Red Beach/Blue Beach
Vieques, Puerto Rico

CH2MHILL

The centralized program management is organized to facilitate communication with and reporting to LANTDIV and to expedite and support project execution. The Program Manager has total authority, responsibility, and accountability for managing the contract. He will be involved in the decision-making process, and in oversight of the management of the project.

The CH2M HILL OE/MEC Manager provides specialized technical support and training during the implementation of OE/MEC removal activities. The Director of CH2M HILL's OE/MEC department is Mr. Ben Redmond. The OE/MEC Manager monitors advances in OE/MEC technology and advances the state of the art for OE/MEC operations. In this role, Mr. Redmond ensures that the best technical approach is utilized on each specific OE/MEC project.

The Senior UXO Supervisor (SUXOS) will be provided by our subcontractor, USA Environmental, Inc., and will be the most senior UXO Technician onsite. Mr. Dan Miller of USA Environmental will be the SUXOS, and will directly control the operations of all field teams performing OE/MEC activities. He will spend most of the day in the field monitoring their performance and assisting them in achieving maximum operational safety and efficiency. He reports directly to the Site Superintendent and receives guidance from the CH2M HILL UXO Manager concerning technical OE/MEC and operational issues. He will implement the approved plans in the field and must review and approve any changes to the approved OE/MEC plans. He will supervise all OE/MEC teams on a project, not to exceed a total of 10. The SUXOS has the authority to stop work temporarily to correct an unsafe condition or procedure. The SUXOS will exceed the requirements of the DoD Explosive Safety Board (DDESB) approved "UXO Personnel Training and Experience Hierarchy."

The Project Manager, Mr. Marty Clasen, P.G., reports to the Clean II Program Manager. He is responsible for ensuing that all activities performed by CH2M HILL at Blue Beach and Red Beach are conducted in accordance with contractual specifications and approved Work Plans. The Project Manager will also coordinate with the NSRR representative. The CH2M HILL Project Manager is responsible for management of all operations conducted for the project. He will ensure that all personnel assigned to the project, including subcontractors, have reviewed the technical plans before any tasks associated with the project begin. The CH2M HILL Project Manager will monitor the budget and schedule to ensure availability of necessary personnel, equipment, subcontractors, and services. He will participate in the development of the field program, evaluation of data, and reporting.

The Project Superintendent, Mr. Fernando Ferreira, has responsibility for all HTRW fieldwork performed by CH2M HILL at Blue Beach and Red Beach. He will coordinate with the SUXOS to ensure that no conflicts in operations occur(except for operations where a SUXOS is in charge of OE/MEC activities). The Site Superintendent will be responsible for overseeing scheduling and ensuring that field-related activities are performed in accordance with the specified plans.

The Project Geophysicist, Mr. Marty Miele of CH2M HILL, is responsible for oversight of the geophysical portion of OE/MEC-related activities at Blue Beach and Red Beach, working closely with the senior field geophysics personnel from the selected subcontractor. The Project Geophysicist will be responsible for approval of the geophysical methods and procedures used during the field activities to obtain the required data, and will provide quality control (QC) during the anomaly selection process. The Project Geophysicist will

report directly to the Project Manager. The Project Geophysicist will assist in providing solutions to geophysical problems encountered in the field in order to meet the required geophysical objectives of the project.

The Site Geophysicist, Mr. Preston Hawkins of NAEVA, will be responsible for day-to-day operations of the geophysical investigation, working closely with the Project Geophysicist.

UXO Technician III personnel, also referred to as field team leaders, are responsible for the safety and efficiency of the performance of their assigned field team, and report directly to the SUXOS. The UXO Technician III can stop work temporarily to bring an unsafe condition or procedure to the attention of the SUXOS. The UXO Technician III will exceed the requirements of the DDESB-approved "UXO Personnel Training and Experience Hierarchy."

UXO Technician II personnel report directly to their assigned UXO Technician III and are responsible for the safe and efficient performance of specific field tasks as assigned by the UXO Technician III. They are also responsible for complete familiarity with the approved plans and for adherence to the procedures described in the plans. A UXO Technician II has the authority to stop work temporarily to bring an unsafe condition or procedure to the attention of their assigned UXO Technician III. The UXO Technician II will exceed the requirements of the DDESB-approved "UXO Personnel Training and Experience Hierarchy."

UXO Technician I personnel report directly to their assigned UXO Technician II or III and are responsible for the safe and efficient performance of specific field tasks as assigned. They are also responsible for complete familiarity with the approved plans and for adherence to the procedures described in the plans. A UXO Technician I has the authority to stop work temporarily to bring an unsafe condition or procedure to the attention of their assigned UXO Technician II or III. The UXO Technician I will exceed the requirements of the DDESB-approved "UXO Personnel Training and Experience Hierarchy."

The Program Certified Industrial Hygienist (CIH), Mr. Mike Goldman of CH2M HILL, will oversee the development and implementation of the Site Safety and Health Plan (SSHP) to ensure that it meets all specific needs of the project and that appropriate health and safety requirements are defined.

The UXO Safety Officer (UXOSO), Mr. Gary Webb of CH2M HILL, will be responsible for implementing the SSHP, inclusive of the OE/MEC and HTRW components, and will verify compliance with applicable safety and health requirements. On this project, the UXOSO will report independently of project management to the Program CIH. The UXOSO will implement the approved explosives and UXO safety program in compliance with all DoD, federal, state, and local statutes and codes; analyze UXO and explosives operational risks, hazards, and safety requirements; establish and ensure compliance with all site-specific safety requirements for UXO and explosives operations; enforce personnel limits and safety exclusion zones (EZs) for UXO clearance operations, UXO and explosives transportation, storage, and destruction; conduct safety inspections to ensure compliance with UXO and explosives safety codes; and operate and maintain air monitoring equipment required at the site for airborne contaminants. The UXOSO has the authority to stop work temporarily to correct an unsafe condition or procedure. The UXOSO will exceed the requirements of the DDESB-approved "UXO Personnel Training and Experience Hierarchy."

The QC Supervisor, Mr. John Tomik of CH2M HILL, is responsible for ensuring that the overall QC procedures and objectives of the project are met. The QC Supervisor will review and ensure that the Quality Control Plan (QCP) (Section 6 of this Work Plan) addresses all project-specific QC needs and all appropriate QC requirements.

The UXO Quality Control Specialist (UXOQCS) will be responsible for implementing the UXO-specific sections of the QC Program for all OE/MEC-related evolutions; will conduct QC inspections of all UXO and explosives operations for compliance with established procedures; and will direct and approve all corrective actions to ensure that all OE/MEC-related work complies with contractual requirements. The UXOQCS has the authority to stop work temporarily to correct an unsafe condition or procedure. On this project, the UXOQCS will report independently of project management to the Program QC Supervisor. The UXOQCS will exceed the requirements of the DDESB-approved "UXO Personnel Training and Experience Hierarchy."

Subcontractors. CH2M HILL may use subcontractors for major work elements at AFWTF and EMA or on other Task Orders. When this work is subcontracted, it will be done in accordance with Clean II contract requirements. Subcontracted work will include Digital Geophysical Mapping and OE/MEC identification and handling. Subcontractor personnel will work as team members following lines of authority and reporting relationships applicable to all personnel onsite.

2.1.3.1.1 Project Field Communication

Figure 2-2 depicts the line of communication for the Blue Beach and Red Beach OE/MEC field investigation, according to the chain of command described in the following paragraphs.

The subcontractors, USA Environmental and NAEVA, will report directly to CH2M HILL field personnel. USA's SUXOS, Dan Miller, will report directly to the Site Superintendent, Fernando Ferreira. The Site Geophysicist, Preston Hawkins of NAEVA, will also report directly to Mr. Ferreira.

The Site Superintendent, Fernando Ferreira, will coordinate with Navy EOD Master Chief Ancelet from NSRR in the event that OE/MEC is encountered and needs to be disposed. Mr. Ferreira will report directly to the Project Manager, Marty Clasen.

The Project Manager, Marty Clasen, will coordinate with CH2M HILL UXO Manager Ben Redmond and QC Supervisor John Tomik for senior technical advice. Mr. Clasen will report directly to Mr. Chris Penny, the LANTDIV RPM.

The LANTDIV RPM, Chris Penny, works individually with Ben Redmond and John Tomik and will report significant findings directly to Mr. Rick Urbanski of NOSSA.

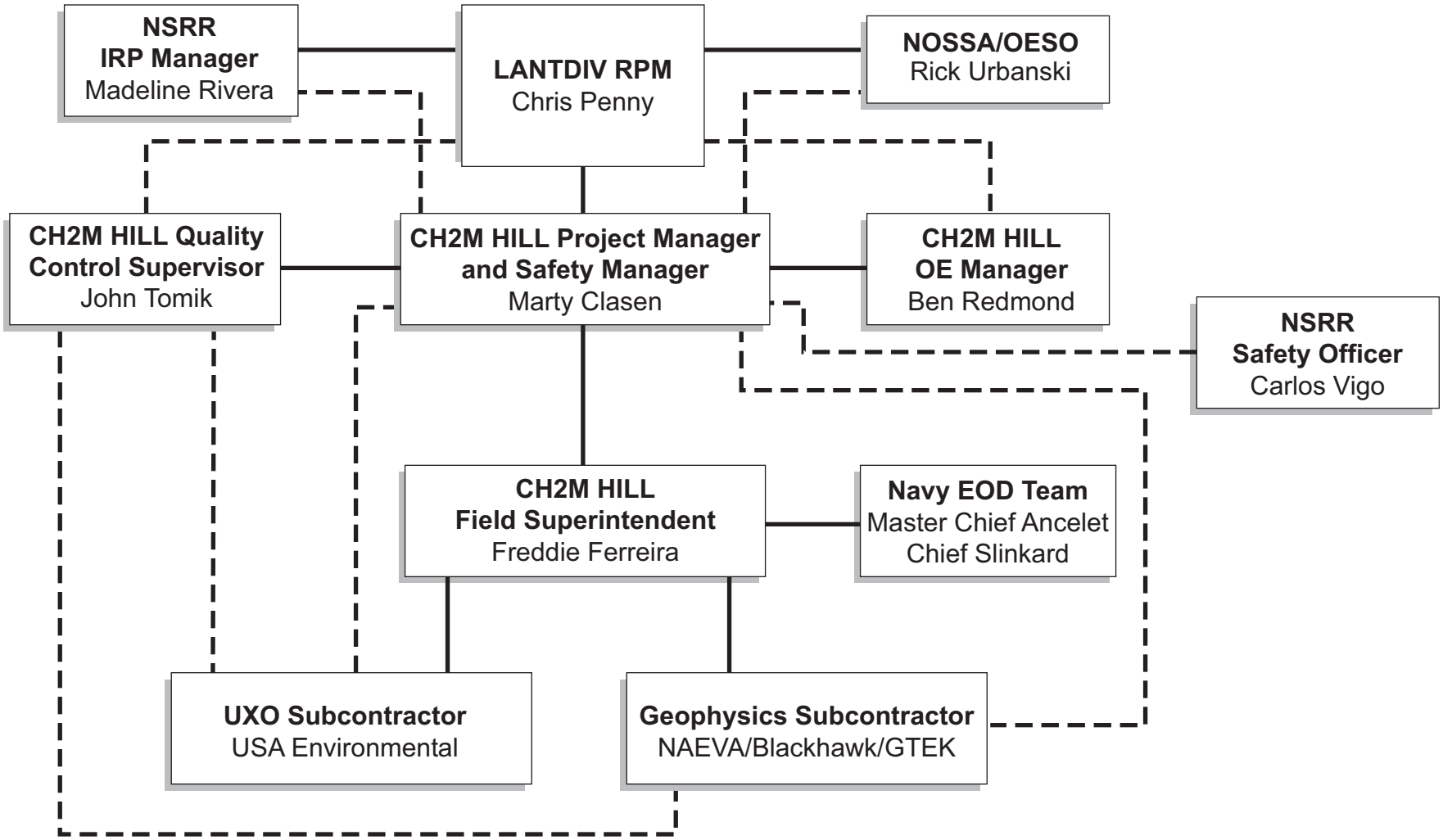

FIGURE 2-2
Red Beach/Blue Beach UXO
Project Field Communication Plan

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2.1.3.1.2 Field Decision Making Process

This section describes the actions to be taken in the field regarding the field investigation process, as shown on Figure 2-3.

The chain of command for the field activities is as follows:

The Site Superintendent, Fernando Ferreira, will be the direct supervisor for the subcontractors. All activities will be channeled by him to the CH2M HILL Project Manager, Marty Clasen. Senior technical advice to the Project manager will be provided by John Tomik, QC Supervisor, and Ben Redmond, UXO Manager. The Project Manager reports to the LANTDIV RPM, Chris Penny, who, in turn, will update significant UXO activities to Rick Urbanski and Mr. Ed Klinghoffer of NOSSA.

USA Environmental will perform the visual sweep of the Blue Beach and Red Beach areas, along the access roads, and in the walkable portions of the vegetated area between the beach and the roads. If OE/MEC is not found during the visual sweep, then USA Environmental will report to the Site Superintendent, Fernando Ferreira. Mr. Ferreira will then report to the CH2M HILL Project Manager, Marty Clasen, who, in turn, will report to the LANTDIV RPM, Chris Penny. If OE/MEC is encountered while performing the visual sweep, the following course of action will be taken:

The Site Superintendent will notify Dan Miller of the USA Environmental UXO Team and, along with the NSRR EOD team, will determine whether the OE/MEC can be removed safely to a designated secure area for eventual disposition. If the OE/MEC is not safe to remove, refer to section 2.1.3.1.3 for the logistics involved and notify the CH2M HILL Project Manager of the situation immediately. If the EOD Team determines that removal of the OE/MEC is safe, the Site Superintendent will notify the Project Manager of the decision by the EOD Team. The Project Manager will notify the LANTDIV RPM, who will convey the information to NOSSA in his weekly conference call to provide an update of the field activities.

NAEVA will be the geophysical contractor in charge of the EM-61 survey of the area. If no anomalies are identified, NAEVA will report to the Site Superintendent and the chain of command will be initiated as described previously. If anomalies are encountered while surveying the area, the Site Superintendent will be notified by NAEVA and the Site Superintendent will notify the PM. The area where the anomaly was encountered will be verified by USA Environmental. If no OE/MEC is found, USA Environmental will report to the Site Superintendent, and the information will follow the chain of command to the LANTDIV RPM. If OE/MEC is found, the Site Superintendent will be notified. The Site Superintendent will call in the Navy EOD Team for the disposition of the item(s) and Master Chief Ancelet will determine whether the OE/MEC is safe to remove from the area. If it is not safe to remove, the procedures outlined in the following paragraphs will be followed.

Upon notification of the EOD Team, the CH2M HILL Project Manager will be contacted immediately. Depending on the circumstances and the type of material that needs to be disposed, the Navy will determine the control measures to be taken. Upon the decision to perform a blow-in-place of the OE/MEC, LANTDIV will be notified. If the OE/MEC is to be removed, LANTDIV can be notified of the situation during the programmed weekly conference calls.

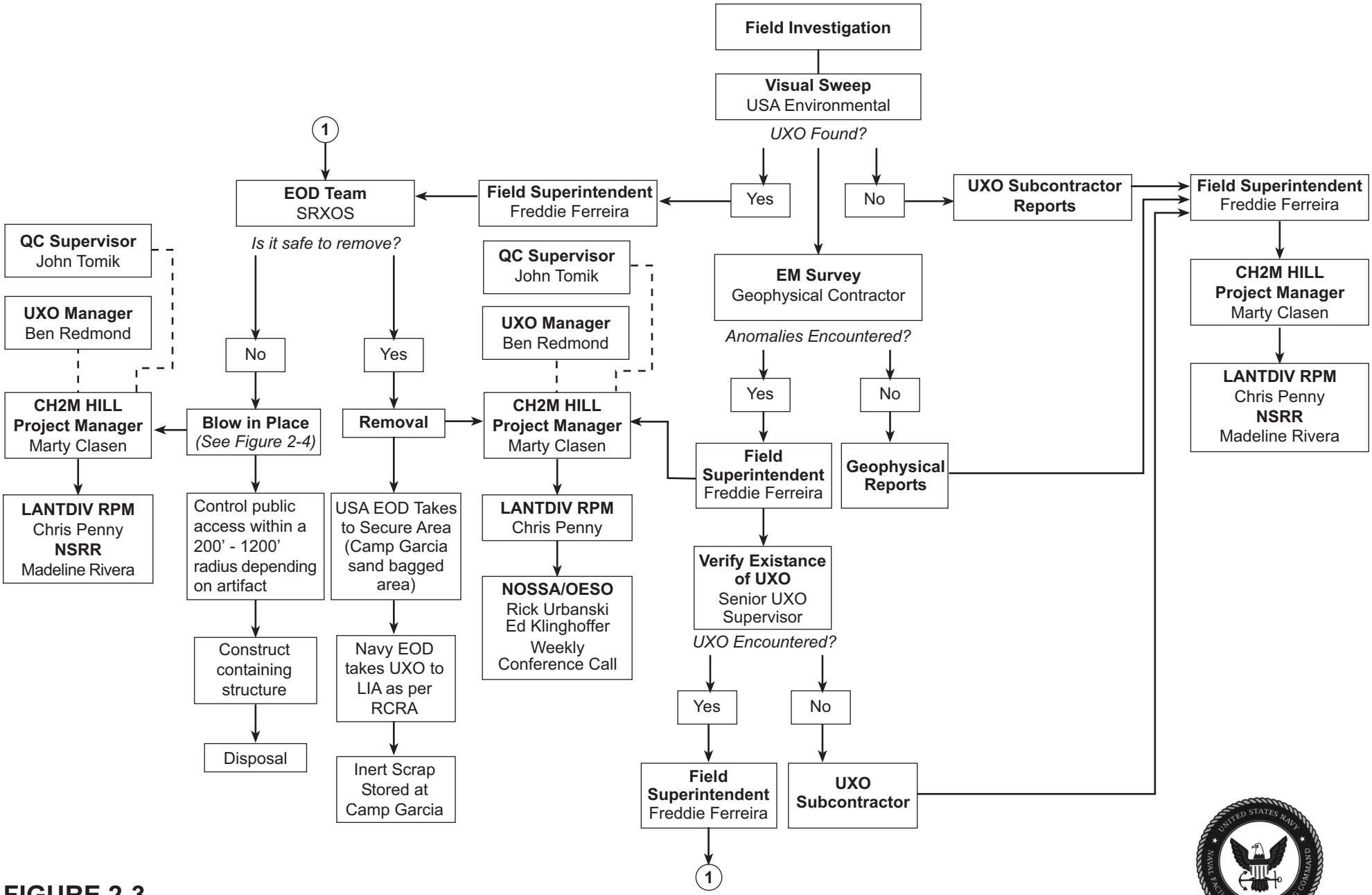

FIGURE 2-3
Red Beach/Blue Beach
Field Decision Making Procedures

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2.1.3.1.3 Blow- in -Place Decision Tree

The following chain of command pertains to the process of disposal of OE/MEC by the blow-in-place method. Figure 2-4 illustrates the process as a flow chart.

The USA Environmental UXO Team, headed by Dan Miller, determines whether the OE/MEC is safe to move. He notifies the CH2M HILL Project Manager if he determines that the OE/MEC is unsafe to move and a blow-in-place must be performed. The Project Manager initiates a conference call in which all affected parties are notified of the determination. The UXO Manager, Ben Redmond, and the QC Supervisor, John Tomik, provide their input, and LANTDIV RPM Chris Penny will be notified of the result.

The Navy will determine the extent of the EZ and the relative risk of OE/MEC on Blue Beach and Red Beach. If a high risk of OE/MEC along the beach exists, the option to be used is blow-in-place. The investigation will be stopped while the appropriate institutional controls are installed. A fence with a gate will be placed around the perimeter of the beach, limiting access to authorized personnel only. Follow-on screening activities will be conducted as directed by NOSSA and LANTDIV.

If it is determined that a low risk of future OE/MEC exists, the OE/MEC found will be blown in place and the geophysical investigation will continue.

2.1.4 Data Quality Objectives

Data Quality Objectives (DQOs) are the qualitative and quantitative statements developed to clarify study objectives, define the type of data needed, and specify the tolerable levels of potential decision errors. DQOs are used as the basis for establishing the type, quality, and quantity of data needed to support the decisions that will be made for the Preliminary OE/MEC Investigation of Blue Beach and Red Beach. The following site-specific DQOs will result in obtaining the necessary information to determine whether OE or UXO is present at Blue Beach and Red Beach:

- All existing survey and mapping data and the archival records of the project area will be reviewed and integrated into GIS.
- Location and mapping performed shall be recorded and plotted in feet.
- Spatial Coordinate Reference System will utilize existing control markers referenced to Puerto Rico/Virgin Islands State Plane Coordinate System North American Datum (NAD) 83. The base mapping will be accomplished in feet.
- Control markers will consist of non-metallic stakes.
- Accuracy will meet minimum standards as defined in the OE Master Work Plan (CH2M HILL, October 2001).
- Geospatial Data Standards will match GIS requirements.
- The Geophysical Survey Plan will include standardization of equipment and instruments used in acquiring geospatial data and producing location and mapping products.

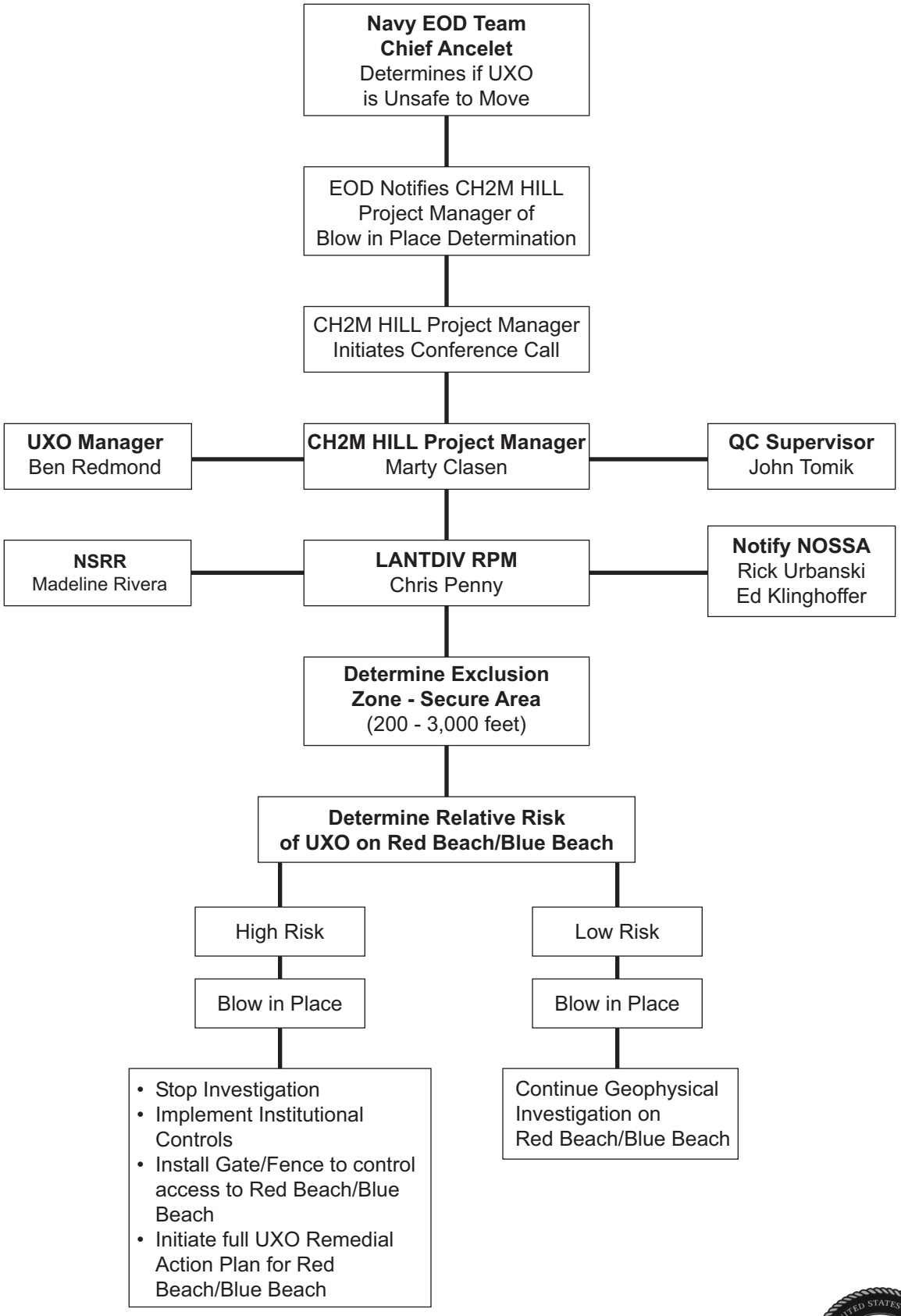

FIGURE 2-4
Red Beach/Blue Beach UXO
Blow-in-Place Decision Tree

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2.2 Technical Scope

The technical scope of work is to perform a Preliminary OE/MEC Investigation of Blue Beach and Red Beach to determine the presence or absence of OE/MEC. The Blue Beach and Red Beach area of investigation consists of clear open beach areas and associated beach access roads that encompass approximately 20 acres between the two beaches.

To accomplish this objective, the following tasks will be performed:

- Project planning
- GIS
- Mobilization
- Site layout
- Anomaly Avoidance Sweeps
- Surface OE/MEC and scrap metal removal
- Development of Test Plots (grids)
- Digital Geophysical Mapping
- Anomaly analysis
- Anomaly reacquisition
- Anomaly validation
- Anomaly recovery
- Reporting and Disposition of OE/MEC
- Disposition of OE/MEC Related Scrap
- Community Relations
- Demobilization
- Preliminary OE/MEC Investigation Report

Grid sizes, layout, and software to be used in the investigation will be defined in the Geophysical Survey Plan.

2.2.1 Project Planning

The CH2M HILL Program Manager, Project Manager, UXOSO, and QC Supervisor will provide project management for daily field oversight, track budget and schedule of field exercises, provide weekly reports to the Navy Technical Representative (NTR), review invoices, prepare monthly progress reports, provide technical review of major project deliverables, prepare project correspondence, and coordinate with LANTDIV, NSRR, and subcontractors.

One meeting is proposed to be held at Vieques Island between LANTDIV and CH2M HILL. It is assumed that the Project Manager, the Program Manager, the UXOSO, and the SUXOS will travel to Vieques for the meeting. The meeting will be held following submittal of the work plan to identify the OE/MEC investigation area. This task also includes two meetings at LANTDIV to determine DQOs, discuss preparation for mobilization, and discuss the results of the Preliminary OE/MEC Investigation Report.

2.2.2 Geographical Information System

All data will be collected in preparation for the creation of a GIS tailored for the specific ordnance investigative needs of the site. All digital data will be created using a software platform that will allow it to be loaded directly into the OE/MEC GIS system. The main purpose of the GIS is to assemble all the data required to associate the non-intrusive subsurface geophysics investigative data to its correct geographical location, the relational database, mapping, and remote sensing data. The GIS tools are used to manage the project, assemble data for the administrative record, and help determine areas requiring further investigation. The level of effort estimated for this task is based on the assumptions that an electronic base map will be provided, that survey grid information will be provided in electronic format (ASCII, CAD, or shape files), and that OE/MEC information will be delivered in electronic tabular format (Microsoft Excel).

The use of GIS for Blue Beach and Red Beach will be limited to the development and maintenance of data from the geophysical survey, production of a site map, the posting of new data to the existing Vieques Island WebGIS, and the development of "identify-like" functionality for the Vieques Island WebGIS. "Identify" functionality refers to the functionality that allows the WebGIS user to access feature attributes by clicking on a feature in the WebGIS map display. The GIS Specialist will develop an OE/MEC dataset from information provided on a representative sample of OE/MEC pieces at Blue and Red Beaches. Data will be posted once to the existing Vieques Island Web GIS at 100 percent completion.

2.2.3 Mobilization

This section presents the requirements for pre-mobilization, mobilization, and project setup.

2.2.3.1 Pre-Mobilization

Prior to mobilization, the following actions require advance planning in preparation for mobilization:

- Finalize procurement actions for items and services needed during the mobilization
- Coordinate with the Federal Aviation Administration (FAA) to consider establishing a Controlled Firing Area (CFA) or other procedure if regular detonations are expected (none are expected for this assignment at Blue Beach and Red Beach).
- Notify local response agencies (fire department, hospital) of upcoming project activities
- Coordinate with NSRR Environmental Manager, Madeline Rivera

2.2.3.2 Mobilization

A mobilization period will be necessary to mobilize, organize, and train the staff, and to mobilize, inventory, and test equipment. Mobilization activities will include:

- Transport and assembly of the work force
- Conducting site-specific training on the work plan, SSHP, and OE/MEC procedures and hazards

- Shipping and inventory of project equipment including geophysical detection equipment, hand tools and supplies, portable toilets, backhoes, vegetation clearance equipment, etc.
- Coordination with local agencies including police, hospital, and fire department as appropriate
- Organizing support facilities and testing communication equipment
- Testing and inspecting equipment

2.2.3.3 Field Office

A project field office will be established at a location to be determined. The field office will be the central command location for direction and coordination of OE/MEC activities. Personnel will report to this building at the beginning of each work day for the daily health and safety briefing. The field office will be the central point of communications for the project. The office will be equipped with one or more telephones, a facsimile machine, and a radio base station for radio communication with the field crew(s). Health and safety records will also be maintained in the field office. Building 301 at Camp Garcia is expected to be available to serve as the project field office.

2.2.3.4 Kickoff/Safety Meeting

During mobilization, a kickoff/site safety meeting will be conducted. This meeting will include a review of the work plan, and review and acknowledgment of the SSHP by all site personnel.

2.2.4 Site Layout

The survey team will conduct an initial reconnaissance of the site upon mobilization. During the initial reconnaissance, the survey team will examine the site to determine the amount of vegetative material, if any, that must be removed to accomplish the scope of work and determine the amount of OE/MEC present on the surface of the site. The survey team will document the site reconnaissance with a digital video camera. Digital photographs will also be taken of the overall site, OE/MEC, debris found on the surface, and any other notable features. The photographs will then be available for viewing during subsequent meetings or planning sessions.

The survey team's observation, documentation, and analysis of the density of the vegetation, if any, and the presence of surface OE/MEC will be used to determine the amount and method of vegetation removal, if required. Possible appropriate vegetation removal scenarios include:

- None (as is expected at the two beaches) if the area is free of vegetation that interferes with subsequent required work
- Mowing (in areas that are heavily vegetated but have little or no signs of shock-sensitive OE/MEC on the surface)
- Removal by hand cutting or burning (in areas with heavy vegetation with evidence of shock-sensitive OE/MEC on the surface)

The survey to establish site boundaries encompasses actions performed to identify the operating area boundaries; install individual grid corner stakes; and develop a Project Base Map.

Following the initial reconnaissance of the work area, the survey team will locate and mark the site boundaries with stakes and establish ground controls in accordance with the geophysical survey plan and the location, surveying and mapping plan. The spatial coordinates collected during the establishment of the survey monuments, operating area boundary, and individual search grids will be used to develop a Project Base Map.

The final product of this operation is the generation of a spatially-referenced site drawing that accurately depicts the location operating area boundaries and grid boundaries. Throughout operations, this map will be updated continually to reflect project performance and contamination encountered. Upon completion of the project, the data contained on this map will be used to generate the final report.

All stake locations will be checked for the presence of OE/MEC using an appropriate geophysical instrument prior to placement of the stake.

2.2.5 Anomaly Avoidance Procedures

Anomaly avoidance refers to techniques employed by UXO personnel at sites with known or suspected OE/MEC to avoid any potential surface OE/MEC and any subsurface anomalies.

2.2.5.1 UXO Team Composition

For anomaly avoidance on a site with known or suspected OE/MEC, the UXO team will provide onsite support during all activities. The UXO team will be composed of a minimum of two UXO-qualified personnel, depending on the tasks to be performed. One UXO team member will be a UXO Technician III and the other will be a UXO Technician II.

2.2.5.2 Procedures

Prior to vegetation removal or installation of boundary markers onsite, the UXO team will conduct a reconnaissance of the area. The reconnaissance will include locating a clear path for the crews, vehicles, and equipment. Consideration will be given for possible OE/MEC contamination. OE/MEC may be found on the surface or in the subsurface. The boundary of each access route and investigation site should be marked using white survey flagging and pin flags. Non-UXO-qualified personnel will not be allowed outside designated access areas without proper UXO escort. Near-surface anomaly locations will be identified prominently with yellow survey flagging or pin flags. Red flagging will be placed adjacent to any discovered OE/MEC for subsequent visual reference. The approach path will be, at a minimum, twice the width of the widest vehicle. The boundaries of the approach path will be clearly marked to prevent personnel from straying into uncleared areas. If OE/MEC is encountered, the UXO team will mark and report the item, and divert the approach path around the OE/MEC.

2.2.6 Surface OE/MEC and Scrap Metal Clearance

As the first step, the UXO technicians will carefully inspect all areas of the grid ahead of the vegetation removal team or the Digital Geophysical Mapping (DGM) team with the aid of

an appropriate geophysical instrument for evidence of OE/MEC partially or fully exposed on the ground surface. The UXO Technicians will mark any OE/MEC or other hazards by encircling the hazard with flagging tape. Non-UXO-qualified personnel will be instructed to avoid working in designated hazard areas. If OE/MEC is discovered on the surface, mechanical equipment will not be used unless the area can first be effectively swept of all surface OE/MEC.

Evidence of likely military training areas will also be noted during the visual OE/MEC survey. Locations of likely training areas will be recorded for subsequent assessment. UXO or OE-related scrap (ORS) identified on the ground surface (or partially exposed) during the visual OE/MEC survey will be removed and properly disposed.

2.2.7 Test Plots

Test plots will be established for the geophysical prove-out and then used as necessary to calibrate geophysical instruments. Details on the type and setup of the test plots are contained in the geophysical survey plan.

2.2.8 Digital Geophysical Mapping

The objective of each geophysical investigation will be to locate all detectable UXO while developing a clear, defensible and complete Administrative Record containing all recorded and developed data. To locate and characterize all detectable UXO with maximum effectiveness and efficiency, the most appropriate geophysical equipment and survey methodologies will be evaluated and selected as identified in the Geophysical Survey Plan.

2.2.8.1 OE/MEC Detection Performance Goal

The performance goal for OE/MEC detection capability is described by one of two equations that describe the OE/MEC detection depths for different size ordnance items. These relationships reflect the fact that OE/MEC detection capability is reduced with greater OE/MEC depth and/or decreased OE/MEC size. Equation 1 shows the logarithmic detection criteria for magnetometry. Equation 2 shows the logarithmic detection criteria for electromagnetic geophysical detection methods.

Equation 1 (magnetometry)
$\text{Log}(d) = 1.354 \log(\text{dia}) - 2.655$

Equation 2 (electromagnetics)
$\text{Log}(d) = 1.002 \log(\text{dia}) - 1.961$

Where:
dia = diameter of minor axis of OE/MEC, in millimeters.
D = required depth of detection to top of buried OE/MEC, in meters.

2.2.8.2 Horizontal Accuracy

Horizontally, 98 percent of all excavated items must lie within a 20-centimeter radius of their mapped surface locations as marked in the field after reacquisition.

2.2.8.3 False Positives

There will be no more than 15 percent "false positives" where anomalies reacquired by the Contractor result in no detectable metallic material during excavations. This will be determined during anomaly validation. If the false positive rate is greater than 15 percent, the geophysical instrument will be re-calibrated. Calibration procedures are provided in Section 6 of this Work Plan.

2.2.9 Anomaly Analysis

The target analysis process culminates in the creation of Dig Sheets, which contain target location, depth, and weight estimates. The Dig Sheets will also contain listings of the peak raw amplitudes recorded on sensors and the distance from the peak amplitude to the 50 percent amplitude level. These amplitude values are used to verify that the correct target is validated. For each grid, the following factors will be assessed prior to generating an anomaly list:

- The local background conditions of the magnetic, gradiometric, or electromagnetic response
- An evaluation of data completeness and accuracy
- An assessment of data quality based on the survey and grid Quality Assurance (QA) data
- The grid boundary conditions, utilities and/or other cultural features present, and unsurveyable areas (beneath roads, trees, buildings, etc.)
- A delineation of the extent and boundaries of metal-rich areas, if any (Anomaly lists will not be generated for metal-rich areas.)

The criteria for selecting and locating anomalies for the anomaly list include the following:

- The maximum amplitude of the response
- The maximum amplitude of the response with respect to local background conditions
- The lateral extent (plan size) of the area of response
- The 3-dimensional shape of the response
- The location of the response with respect to the edge of the grid, unsurveyable areas, land features, cultural features, or utilities within or adjacent to the grid
- The shape and amplitude of the response with respect to the response of known targets buried in the geophysical prove-out test plot
- The shape and amplitude of the response with respect to relevant anomalies encountered in previous OE/MEC removal grids
- The apparent depth of the anomaly
- Potential distortions in the response as a result of interference from nearby cultural features
- Supplemental analysis of the top coil or differential data as necessary
- Any instrument or grid survey QC that could affect the analysis

The Project Geophysicist will analyze the geophysical data for each OE/MEC removal grid, identify anomalies that may represent buried OE/MEC, and prepare anomaly lists containing the following information:

- Project site
- Geophysical contractor
- Responsible geophysicist
- Grid identification
- Grid corner locations in State Plane coordinates
- Grid background response levels
- Unique anomaly identification numbers
- Predicted anomaly easting and northing in both local grid (relative) coordinates and in State Plane coordinates
- Instrument peak value at each anomaly location

The anomaly lists will be prioritized and anomalies deemed more likely to be OE/MEC will be ranked higher than anomalies less likely to be OE/MEC. A proposed, grid-specific "cut line" for preparation of the dig sheet will also be provided. The dig sheet will be of a subset of the anomaly list. Anomalies below the "cut line" generally will not be excavated unless warranted by field conditions. Each anomaly list will be accompanied by a proposed "cut line" separating the recommended dig locations from the anomalies unlikely to represent OE/MEC. The "cut line" for each grid will be established based on the site conditions for each OE/MEC removal grid. Further details are provided in the Geophysical Survey Plan.

2.2.10 Anomaly Reacquisition

Before intrusive activities can be performed, the geophysical anomalies identified on the digital geophysical surveys must be reacquired. Anomaly reacquisition is a two-step process. The first step is to locate the ground position of the anomaly coordinates as specified on the dig sheet. This will be performed using differential global positioning systems (GPS), USRADS, conventional survey methods, or measuring tapes, based on local site conditions. A white non-metallic pin flag, labeled with the unique anomaly number, is placed in the ground at the indicated grid coordinates. The second step is to use the same instrument used to detect the target (total field magnetometer, vector gradiometer, or electromagnetic sensor) to identify the peak location of the anomaly (precise location on the ground where the excavation should occur). The sensor will be moved back and forth over the general area of the anomaly coordinates until the peak value of the anomaly is located. If more than one peak is located, the peak with the highest amplitude will be selected. If no unique peak value is present (i.e., the same peak value is measured over an area), the center of the maximal area will be selected. If no peak value is located at the indicated location, the white anomaly location flag will be left in place and the Project Geophysicist will be consulted.

The peak value measured over the anomaly will then be recorded and the dig location will be marked with a colored flag labeled with the anomaly number. The specified relocation process serves three purposes:

1. It focuses the excavation over the actual anomaly peak, instead of an interpolated location between the survey measurement points
2. It reduces measurement errors
3. It provides a QC ground check for the dig locations

All discrepancies between the dig sheet location and the actual reacquired location (and any anomalies that could not be reacquired) will be recorded. The reacquisition location will be measured and logged. The reacquisition coordinates will be used as the official dig location for location QC assessment. Additional details are provided in the Geophysical Survey Plan.

2.2.11 Anomaly Validation

The feedback of ground-truth excavation data is one of the most important ways to ensure efficient and effective UXO geophysical mapping. Excavation data collected during each validation activity will be captured to document the item location, weight, shape, orientation, and depth. This data will be entered electronically into a ground-truth database and incorporated within the GIS.

The feedback process will also populate the database developed for each target signature developed during the data processing and analysis steps. The Site Geophysicist will review the target signatures in conjunction with the integrated ground-truth data to evaluate local geologic and geophysical effects on the target signatures. This information will be described in weekly reports and will be communicated to the staff processing and reviewing geophysical data.

Validation results for each grid will be posted on the internet web site within approximately 5 working days of grid completion. The Project Geophysicist or his designee will review the excavation results will respect to the anomaly selection criteria, “cut-line” level selection, QC dig results, actual OE/MEC encountered, and any performance criteria failures, and then will provide a weekly progress report with recommendations. This preliminary investigation at Blue Beach and Red Beach will target only the detection and removal of near-surface (to 1 ft) OE/MEC.

During anomaly validation actions, the UXO Technician III will assign UXO Technicians one or more anomalies to investigate. Validation of anomalies will be performed by a two-person team of UXO Technicians using hand excavation tools to a maximum depth of 1 ft.

2.2.11.1 Hand Excavation Tools

Small hand tools such as shovels, spades, trowels, and pry bars will be used to access potential OE/MEC. The excavation activities will be limited to a depth of 1 ft. Hand tools will be used for the majority of items, which generally are found near the surface. The following basic technique will be used for anomaly excavation:

1. The UXO Technician will relocate the anomaly with an appropriate geophysical instrument.

2. Until the anomaly is identified otherwise, it is assumed the anomaly is OE/MEC. Excavation will be initiated adjacent to the subsurface anomaly. The excavation will continue down until the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with an appropriate geophysical instrument, or until the maximum depth of excavation required by the work plan is reached.

3. Using progressively smaller and more delicate tools to carefully remove the soil, the excavation team will expand the sidewall to expose the metallic item in the wall of the excavation for inspection and identification without moving or disturbing the item.

4. Once the item is exposed for inspection, the excavation team will determine whether it is OE/MEC.

5. If the item is OE/MEC, the procedures of Sections 2.2.11.2, OE/MEC Identification, will apply.

6. If the item is not OE/MEC, it will be removed and the area will be rechecked with the magnetometer to ensure that OE/MEC is not hidden beneath it. The excavation team will then annotate the results of the excavation on the anomaly tracking sheet and move on to the next marked subsurface anomaly.

7. The hole will be backfilled only after the UXOQCS concurs that the excavation is complete.

2.2.11.2 UXO Identification

When an item is positively identified as OE/MEC, the UXO Technician III, SUXOS, and UXOSO will be notified along with the NSRR OE/MEC Safety Representative. An OE/MEC Information Form (Form 2-1), included at the end of this section, will be filled out for each OE/MEC item identified. The UXO Technician will carefully remove enough soil, without disturbing the OE/MEC, to facilitate positive identification or to obtain identification features. UXO Technicians will make every effort to identify OE/MEC through visual examination of the item for markings and other identifying features such as shape, size, and external fittings. Items will not be moved during the inspection/identification until the fuze condition can be ascertained. If the condition is questionable, the fuze will be considered armed. The fuze is considered the most hazardous component of an OE/MEC, regardless of type or condition. The SUXOS and the UXOSO will agree on the positive identification of the item and the disposition of the item before implementing any disposal operations. The following guidelines should be used:

- In general, a projectile containing a Base Detonating (BD) fuze is to be considered armed if the projectile has been fired.

- Arming wires and pop out pins on unarmed fuzes should be secured by taping in place prior to movement.

- Do not rely on the color coding of OE/MEC for positive identification of contents. Munitions having incomplete or improper color-coding have been encountered.

- Avoid the area forward of the nose of a munition until it can be ascertained that the item does not contain a shaped charge. The explosive jet can be fatal at great distances forward of the longitudinal axis of the item. Assume any shaped charge munitions to contain a piezoelectric (PZ) fuzing system until the fuzing system is positively identified. A PZ fuze is extremely sensitive, can function at the slightest physical change, and may remain hazardous for an indefinite period of time.
- Examine a projectile for the presence or absence of an unfired tracer. Also examine the item for the presence or absence of a rotating band and its condition.
- Assume that a practice OE/MEC contains a live charge until it can be determined otherwise. Expended pyrotechnic/practice devices may contain red/white phosphorus residue. Because of incomplete combustion, phosphorus may be present and may re-ignite spontaneously if subjected to friction, or if the crust is broken and the contents are exposed to air.
- Do not approach a smoking white phosphorus (WP) OE/MEC. Burning WP may detonate the burster or dispersal explosive charge at any time.

2.2.11.3 Utility Clearance

Before validating anomalies, a utility clearance will be necessary to identify underground service lines within or near the excavation sites. Although many utilities will be evident from geophysical maps, some utilities such as fiber optic cables, plastic gas lines, and plastic water pipes will not be detected unless tracer lines were installed. If possible, utility clearance for the whole project or large areas will be coordinated at once to minimize the amount of time spent and paperwork generated. Utilities are not expected to be encountered at Blue Beach and Red Beach.

2.2.12 Demobilization

Demobilization may occur for a variety of reasons:

1. The project may be completed with all work accomplished.
2. The project may be incomplete, but the contractor has expended most of the contract funds.
3. Weather conditions may lead to a demobilization.
4. It may be determined that continuing in the present course of action is not in the best interest of the Government.

Whatever the reason, the Government, through its Contracting Officer, must convey officially to the contractor its decision to demobilize from the project site.

2.3.12.1 Demobilization Upon Project Completion

Full demobilization will occur when the project is completed with appropriate QC and QA checks performed. During final demobilization, personnel will be retained only as long as necessary. All personnel no longer needed will be demobilized. The following will occur prior to demobilization:

- All areas to be investigated or cleared will be verified to be completed to the Government's satisfaction

- All areas that could not be investigated or cleared will be identified
- Site restoration will be verified to have been performed to an appropriate level

2.3.12.2 Unscheduled Demobilizations

If weather conditions threaten to force an unscheduled demobilization, the decision to demobilize will be based on an analysis of the cost to stay on the project until the weather clears versus the cost to demobilize. If the number of predicted productive days during the poor weather conditions is sufficient enough to show a benefit by staying onsite, the work can continue.

2.2.13 Reporting and Disposition of OE/MEC

This section discusses the procedures that will be performed by UXO-qualified personnel during surface clearance of OE/MEC, ORS, and anomaly validation. This section includes procedures for validating anomalies, identifying OE/MEC, and transportation and demolition of OE/MEC.

2.2.13.1 Responsibilities of Personnel

General responsibilities of personnel are discussed in Section 2.1.3.1 of this document.

2.2.13.2 Overall Safety Precautions

The general work practices outlined in *Basic Safety Concepts and Considerations for Ordnance and Explosives (OE) Operations, OE MCX, the Interim Guidance Document 00-03* will be followed. Some basic precautions to be followed also include:

- The work periods for field UXO personnel are limited to maximums of 10 hours per day and 50 hours per week. Exceptions to this requirement will be made only in the event that public safety is at imminent risk and with the concurrence of the Contracting Officer.
- Each work team will consist of a UXO Technician III and six or less team members.
- Each work team will have at least two UXO-qualified personnel.
- The SUXOS will oversee no more than 10 UXO Technician IIIs.

Operations will be stopped and secured 30 minutes prior to sunset.

2.2.13.3 Data Reporting

The collection of accurate and detailed data is essential to documenting the investigation for future reference. Data regarding each metallic anomaly will be recorded in the field as OE removal actions are performed. Data will be recorded electronically on portable field computers, or by hand (pen and paper) if this is the most effective approach.

A grid data packet will be created for each new grid to be cleared. The UXO Technician III will retain the packet in the grid during clearance activities. Each packet will contain a map showing the location of the grid and the following forms (included at the end of this section):

- Grid Summary Sheet (Form 2-2) identifying grid summary information, including:
  - Grid Name or ID
  - Southwest Grid Corner Coordinates
  - Grid Dimensions and Acreage
  - UXO Team Personnel
  - Number of Anomalies Detected and Excavated
  - Number of QA Anomalies Excavated
  - Total Number of OE/MEC Found
  - Total Weight of OE/MEC Scrap Removed
  - Total Weight of Non-OE Scrap Removed
  - Hours Worked Each Day Performing Various Tasks
  - Team Leader/SUXOS/UXOQCS/USACE Signature Blocks
- Anomaly Tracking Sheet (Form 2-3) listing individual anomaly information including the following information to be entered by the Geophysical Analysis Team and the Geophysical Reacquisition Team:
  - Anomaly Number: A unique anomaly number will be assigned for each anomaly. The anomaly number will include the grid ID, anomaly type (DGM or MAF [mag and flag]), and sequential three-digit anomaly beginning with 001. For example, the fourth DGM anomaly in grid 152 would have the following unique ID: 152DGM004. All QA anomalies will also be numbered starting with 001, with the letters QA inserted as shown: 152-QA-001. This nomenclature may be modified for each project as specified in site-specific work plans.
  - Survey Easting: Based on the original survey data, the predicted eastern distance of the anomaly in feet from the southwest corner of the grid.
  - Survey Northing: Based on the original survey data, the predicted northern distance of the anomaly in feet from the southwest corner of the grid.
  - Reading: The maximum bottom coil electromagnetic (EM) response in millivolts (mV) for the anomaly.
  - Comments: Any information that should be noted. For instance, it may be useful to note that the anomaly is small in comparison to local background readings because of nearby cultural influence (utility) or other anomalies.

The following information will be entered on Form 2-3 by the Geophysical Reacquisition Team:

- Reacquire Easting: Based on reacquisition, the predicted eastern distance of the metallic item in feet from the southwest corner of the grid.
- Reacquire Northing: Based on reacquisition, the predicted northern distance of the metallic item from the southwest corner of the grid.
- Reacquire Comments: Any observations of importance during reacquisition such as "no peak was observed" or "multiple peaks were observed." This will provide information that may be useful in the excavation/completion process.

- Pre-Dig Reading: The total bottom coil EM response in mV on the reacquire coordinate. This value should be similar to the original survey Total Reading and provides a check that the correct anomaly has been reacquired. This value also provides a "before" value for comparison.
- Post-Dig Reading: The total bottom coil EM response in mV on the reacquired coordinate after the anomaly has been excavated. This "after" value is used for comparison to the Pre-Dig Reading to justify dig completion.
- Post-Dig Completion Comments: Provides rationale for considering the dig to be complete. One of the following criteria should be met:
  a. At least 90 percent of the observed peak in the EM readings that caused the anomaly to be selected has been removed from the signal.
  b. A large metallic item has been identified in the hole but is too large to remove.
  c. The hole has reached 1 ft and the EM readings indicate that the item is below 1 ft.
  d. Other justification (specify).
- Initial when dig is considered complete: The Geophysical Team initials when the dig has been tested and is determined to be complete.

The following information is to be entered on Form 2-3 by the UXO Team:

- Nature: The nature of the anomaly will be one of the following three potential entries:

  U – Stands for OE/MEC and requires this item to be listed on the OE/MEC Tracking Sheet

  F – Stands for "frag," but could be any non-OE/MEC or OE/MEC-related item

  O – Stands for other and is considered to be any item other than OE/MEC-related items
- Depth: The depth to the top of the item in inches
- Orientation: For elongated items similar to munitions, the approximate degrees from horizontal
- Item Description: A brief description of what was found

- OE/MEC Tracking Sheet (Form 2-4), listing data for each OE/MEC encountered, including:
  - Unique Anomaly Number: The corresponding anomaly number as shown on the anomaly tracking sheet.
  - Easting Coordinate: This is the coordinate where the actual OE/MEC was found, and may not necessarily be the Reacquire Easting.

- Northing Coordinate: This is the coordinate where the actual OE/MEC was found, and may not necessarily be the Reacquire Northing.
- Depth to Tip: The depth to the nose of the item in inches.
- Depth to Tail: The depth to the tail of the item in inches.
- Orientation: The geographical direction (N,S,E,W) of the item is pointing, unless vertical.
- Type: The type of ordnance, as specific as possible.
- Filler: The type of filler, such as none, inert, HE, WP, illumination, incendiary, chemical, smoke, etc.
- Fuze: The type of fuze, such as none, inert, point detonating, electric, powder train, base detonating, etc.
- Date Found: The date on which the OE/MEC was found.
- Disposal: The disposal status (e.g., blow-in-place, picked up and carried away [PUCA] for demolition, EOD response, etc.)
- Date Disposed: The date on which the OE/MEC was disposed.
- Comments: Any comments of note.

2.2.13.4 Transportation

Transportation of OE/MEC may be a consideration if it is safe to do so or if a compelling reason exists. Guidelines to determine whether to transport and procedures for transport are discussed in the following subsections.

2.2.13.4.1 Determination of Whether to Transport OE/MEC

Recovered military munitions or OE/MEC will not be moved by personnel unless it is safe to do so. Movement of OE/MEC by hand is authorized only after positive identification and a determination by the UXO Technician III and the UXOQCS, UXOSO, or SUXOS that the OE/MEC is unarmed and safe to move. The SUXOS will take a very conservative approach to UXO transportation and will only consider it when the OE/MEC is positively identified as safe to move.

2.2.13.4.2 Procedures for Transportation of OE/MEC

If onsite movement of OE/MEC for disposal or venting is approved, the OE/MEC will be moved in the position found. Movement of short distances for the purpose of onsite consolidation will be done by hand-carrying the OE/MEC in the position found. Moving the OE/MEC a greater distance (e.g., to another location for disposal or venting) may be done in a specially-equipped pickup truck. The truck will be equipped with appropriate placards and with a non-sparking bed liner and tie-down points. The OE/MEC being moved will be stabilized with sandbags or placed in a wooden box filled with sand and securely tied down. The driver of the transportation vehicle will be followed by another similar vehicle and driver to assist him in loading and unloading the OE/MEC, and also as a back-up in the event of mechanical trouble.

2.2.13.5 Safe Holding Areas

OE/MEC encountered will be left in place pending same-day disposal. The location of the OE/MEC will be marked with caution tape. At least one UXO Technician will be assigned as a guard to ensure that no one disturbs the OE/MEC. A designated area will be established for collection of OE/MEC scrap.

2.2.13.6 Operations in Populated/Sensitive Areas

OE/MEC operations may be required in populated areas or areas that are sensitive because of cultural, ecological, political, or other reasons.

2.2.13.6.1 Populated Areas

In populated areas, EZs will be established based on the type of activity being performed. The UXO Team will be responsible for establishing and maintaining the EZ using roadblocks and flagging when appropriate. If necessary, police services may be used.

2.2.13.6.2 Ecologically Sensitive Areas

Locations of ecologically sensitive areas of Blue Beach and Red Beach, and procedures for performing activities in these areas, are specified in Section 7 of this Work Plan, the Environmental Protection Plan.

2.2.13.6.3 Politically Sensitive Areas

Activities in certain areas may be politically sensitive. A community relations plan is discussed in Section 2.2.15.

2.2.13.7 Demolition Operations

Disposal of recovered OE/MEC will be accomplished by the NSRR EOD Team using approved procedures.

2.2.13.8 Engineering Controls/Exclusion Zone

During certain activities in OE/MEC areas, an EZ with a minimum separation distance will be established to protect the public in the event of both intentional and unintentional detonations. The EZ will establish an area in which only personnel essential to the project will be permitted. Essential personnel are generally considered to be UXO-qualified personnel, but could include other personnel such as heavy equipment operators and geophysical equipment operators, if their presence is essential to the task.

Minimum separation distances for non-detonation activities are discussed in Section 2.2.13.8.1. Based on these sections, Table 2-1 summarizes the basic activities that will be conducted in OE/MEC areas and the basis for determining the appropriate EZ minimum separation distance.

TABLE 2-1
Determining Size of Exclusion Zone

Operation	Basis for Determining Size of Exclusion Zone	Minimum Separation Distance (For Non-Essential Personnel)	Safe Separation Distance (For Other UXO Teams)
Anomaly Avoidance	Unintentional Detonation with low probability because exposure to potential UXO is specifically avoided	Generally requires no EZ, but a 200 ft distance is recommended	Generally requires no EZ, but a 200 ft distance is recommended
Non-Intrusive Site Work such as Vegetation Removal, Geophysical Surveying, Mag & Flag Sweeps	Unintentional Detonation with low probability because no intrusive activities are performed	Generally requires no EZ, but a 200 ft distance is recommended	Generally requires no EZ, but a 200 ft distance is recommended
Anomaly Excavation during OE Removal or Construction Support	Unintentional Detonation	Maximum Fragment Distance of most-probable munition (mpm) (see Table 2-2)	200 Ft
Disposal Operations:	Intentional Detonation		
Non-Fragmenting Ordnance		Greatest of: 328 x (NEW)$^{1/3}$ *OR* debris throw range if known (1,250 ft default)	
< 5" Caliber Fragmenting Ordnance		Greatest of: 328 x (NEW)$^{1/3}$ *OR* Maximum Fragment Distance (2,500 ft default)	
≥ 5" Caliber Fragmenting Ordnance		Greater of: 328 x (NEW)$^{1/3}$ *OR* Maximum Fragment Distance (4,000 ft default)	

2.2.13.8.1 Minimum Separation Distances for Non-Detonation Activities

Certain activities in OE/MEC areas will require EZs even though no explosive detonation is planned. For example, unintentional detonation of UXO could potentially occur while validating geophysical anomalies or removing vegetation at Blue Beach and Red Beach. Although this may be unlikely because of the use of safety procedures, the EZ is required as a precaution to protect nonessential personnel. Minimum separation distances for nonessential personnel during OE/MEC operations at an OE/MEC site shall be determined using the following criteria:

- If the type of OE/MEC is unknown, the distances in Chapter 5, paragraph C5.5.4, of DoD 6055.9 STD, will apply.
- If a Most Probable Munition (MPM) has been established, the maximum fragmentation distance for the MPM, as calculated by Huntsville Center's Engineering Directorate, Structural Branch will apply, or;
- When conditions and OE/MEC hazards permit, the minimum separation distance may be reduced to fit the situation, but in no case shall the distance be less than greatest of the following:
  - A distance at which the hazardous fragment density is less than 1 hazardous fragment per 600 square feet (sq ft)

- A safe separation distance of 200 ft
- The K50 based on overpressure

Reduction of the minimum separation distance as described here will require approval from NOSSA.

The MPM is determined by calculating fragmentation and blast overpressure distances for the expected type(s) of OE/MEC based on historical research or data generated from surface or intrusive sampling. The MPM is the munition that is likely to be encountered and that has the largest fragmentation or blast overpressure distance. The MPM for Blue Beach and Red Beach is a 2-inch photo flash cartridge, based on historical training operations at these two locations. Other possible MEC items at Blue Beach and Red Beach include 5.56 mm and 7.62 mm small arms rounds, .30 caliber rounds, and smoke grenades.

The following detection depth calculations are from formulae published by the Corps of Engineers, Engineering Manual 1110-1-4009, Ordnance & Explosive Response:

Ordnance	Min Dia (mm)	LOG Mag depth*	Mag Depth (m)*	LOG EM depth	EM depth (m)	Mag Depth (ft)*	EM depth (ft)
Photo flash, ferrous, 2 inches	51	-0.34295	0.45	-0.25001	0.56	1.49	1.84
Photo flash, ferrous, 4 inches	101.6	0.06233	1.15	0.04991	1.12	3.79	3.68
CONTROL CALCULATION	105	0.08169	1.21	0.06423	1.16	3.96	3.80

* Ferrous ordnance only

The non-ferrous “bakelite” photoflash cartridges possible for the survey area may be at or near the detection capability of available instrumentation.

2.2.13.8.2 Safe Separation Distance for Multiple UXO Teams

When multiple teams are operating on a site, the safe separation distance between teams will be 200 ft or the K50 overpressure distance for the MPM, whichever is greater.

2.2.14 Disposition of OE-Related Scrap

This section is intended to guide UXO Technicians in the safe and efficient handling and disposal of ORS metal found at Blue Beach and Red Beach. The inherently dangerous characteristics of Ammunition, Explosives and Dangerous Articles (AEDA) dictate the use of special precautions to ensure that demilitarization is performed only by properly trained and technically qualified personnel. Any ORS found at Blue Beach and Red Beach will be moved to a secure storage area and picked up by NSRR EOD personnel. Master Chief Ancelet from NSRR will be contacted at (787) 865-4316 to come and retrieve the OE/MEC. The NSRR EOD team will be responsible for the OE/MEC from that time forward.

2.2.15 Community Relations

CH2M HILL or its subcontractors will only perform community relations when requested by the LANTDIV, NAVFACENGCOM Contracting Officer for a specific task or project. When approached by any person or entity requesting information about a project, site personnel will defer to the Navy onsite representative or installation representative as

appropriate. CH2M HILL will not make available or publicly disclose any data generated or reviewed under this contract or any subcontract unless specifically authorized by the Contracting Officer. Reports and data generated under this task order will become the property of the Government and distribution to any other source is prohibited unless authorized by the Contracting Officer.

During the implementation of actions under the CLEAN contract, the Navy will implement community relations activities based on the assessed level of community interest.

Additional activities may be necessary once the action begins and at completion. Activities for consideration during these key periods may include:

- Issuing a fact sheet to nearby residents and interested community members describing the remedial activities, the steps in implementing the action, the schedule for completion, and period of operation
- Preparing and distributing periodic information updates describing developments at the site
- Holding community workshops and small group meetings before the action begins, during its implementation, and at completion using presentation boards, displays, handouts, and other graphics to clearly present the plans and progress of site remediation
- Providing briefings and press releases for the media
- Updating the information repositories with appropriate documents, such as work plans, fact sheets, brochures, and media releases
- Developing displays showing progress of work and its schedule, to be placed at the information repository or at other places where people gather, such as the town square, museum, and schools
- Posting information and documents to the web site
- Establishing a contact person at the site
- Briefing community leaders, local agencies, and interested community members of key site activities before they occur, explaining how the action will proceed, the schedule, and other issues of interest (such as findings) in a timely manner
- Responding promptly to inquiries and concerns of community members
- Conducting a public ceremony and site tour to acknowledge completion of the action

2.2.16 Preliminary OE/MEC Investigation Report

CH2M HILL shall prepare and submit to the Navy for review a Pre-Draft OE/MEC Investigation Report. Upon receipt of comments from the Navy, an OE/MEC Investigation Report shall be submitted to NOSSA and EPA. Upon receipt of comments from NOSSA and EPA, the contractor shall submit a Final OE/MEC Investigation Assessment Report. This report shall present the visual and geophysical data collected during the OE/MEC investigation. The data shall be analyzed to determine the likely locations of OE/MEC and former military training areas at Blue Beach and Red Beach.

The Preliminary OE/MEC Investigation Report will be organized in the following format:

Chapter 1. Introduction
- 1.1 Background
- 1.2 Project Authorization
- 1.3 Purpose and Scope
- 1.4 Project Team
- 1.5 Project Objectives

Chapter 2. Site Description and History
- 2.1 Location
- 2.2 Physical Description
- 2.3 History
- 2.4 Demographic Profile
- 2.5 Current and Future Site Use
- 2.6 Analysis of Historical Records
- 2.7 Previous Investigations

Chapter 3. Site Characterization
- 3.1 Site Investigations
- 3.2 Source, Nature, and Extent of OE/MEC
- 3.3 Description of Hazards of Specific OE/MEC Encountered
- 3.4 Update of ASR

Chapter 4. Conclusions and Recommendations

Supporting figures also will be incorporated into the document to show the locations of OE/MEC.

The report will, to the extent possible, include the following items:

- Detailed accounting of all OE/MEC and OE-related materials located and destroyed
- A system of daily journals of all activities associated with this SOW. A daily journal for the site will be opened upon first arrival for field operations and closed after demobilization from the project site.
- A recapitulation of exposure data. This will include total number of man-hours worked onsite in OE-related activities, total motor vehicle mileage, number of aircraft flights, total of man-hours flown to support the project, and any information from Accident/Incident Reports.
- All QC documentation
- All scrap turn-in documentation
- Color digital pictures of sufficient quality to allow easy identification of the item being photographed. This will include pictures of selected OE/MEC located during the clearance action, all demolition shots (before and after detonation), and any significant events during the course of the fieldwork. The digital pictures will include the anomaly number in the file name for each picture. The pictures will be imported into the text of the Removal Report.
- A minimum of 60 minutes of narrated videotape depicting all major activities.

- A financial breakdown based on the Work Breakdown Structure for all costs and labor hours used to perform the SOW.
- Detailed OE/MEC clearance maps, which provide accurate information of all areas cleared and to what depths. The maps will be developed on the previously prepared survey drawings to clearly show areas that were not cleared because of the presence of existing buildings, pavement, utilities, or other features. All boundaries shown between cleared and uncleared areas or between areas cleared to different depths will include sufficient survey information so that they can be determined in the field at any future date. The maps should be sufficiently detailed so that they will serve as a permanent record of the extent of all OE/MEC cleared property in the event that existing buildings or other reference features are removed in the future.

FORM 2-1

UXO INFORMATION FORM

DATE/TIME: _____ TRACKING NUMBER: _____

LOCATION: _____

1. ITEMS REMOVED FROM SITE (YES/NO)
2. WHO REMOVED THE ITEM(S)?

   Name:_____ Organization: _____

3. IF ITEMS WERE REMOVED, WHERE WERE THEY TAKEN? _____

   _____

4. ITEMS DESTROYED ONSITE (YES/NO)
5. WHO DESTROYED ITEM(S)?

   Name: _____ Organization: _____

   Time of Detonation:_____ UXO Down Time:_____

6. ORDNANCE ITEMS ENCOUNTERED:

Type	Quantity	Condition	Disposition

7. US NAVY NOTIFIED AT (TIME): _____ REP: _____
8. CH2MHILL PERSONNEL NOTIFIED AT (TIME): _____ REP: _____
9. COMMENTS (Significant events or findings): _____

   _____

   _____

   _____

_____ _____

CH2MHILL UXO Representative (Signature) CH2MHILL UXO Representative (Print Name)

CHECKED BY _____	**APPROVED BY** _____

Form 2-2

Grid Summary Sheet
CH2M HILL - Vieques

Grid ID	Team #	Grid Dimensions	Area (sq ft)	Geophysical Instrument
		x		

Personnel:

Title	Name
Technician III	
Technician II	
Technician II	
Technician II	
Technician II	

Number of Anomalies		
Original		
Corps QA		%
Total		

Scrap Weight (lbs)
OE
Non-OE

WORK RECORD

Date	Grid Prep Hours	Survey Hours	Excavation Hours	QA Hours	Demo Hours	Restoration Hours	Total Hours
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
Total	0	0	0	0	0	0	0

Name	Reviewed by	Signature	Date
	Team Leader		
	SUXOS		
	QC		
	USACE Safety Specialist		

Form 2-3

ANOMALY TRACKING SHEET

Grid Origin Coordinates:				E		N	Grid ID:								
SURVEY DATA				**REACQUISITION DATA**				**POST-DIG DATA**					**DIG RESULT**		
Data Supplied to the Field Teams				**Data Collected by the Field Geophysical Team**									**Data Collected by the UXO Team**		
Anomaly ID	Survey Easting (ft)	Survey Northing (ft)	Total Reading (mV)	Reacquire Easting (ft)	Reacquire Northing (ft)	Reacquire Comments	Pre-Dig Reading (mV)	Post-Dig Reading (mV)	Item Easting (ft)	Item Northing (ft)	Post-Dig Completion Comments: a. 90% of peak removed from signal b. large item not removed from hole c. hole reached 4 ft; source is deeper d. other (specify)	Initial when dig is considered complete	Type: U = UXO F = Frag O = Non-OE	Depth (inches)	Item Description

Form 2-4

UXO TRACKING SHEET

Grid ID												
Anomaly ID	Easting (ft)	Northing (ft)	Depth to Tip (in)	Depth to Tail (in)	Orientation (N,S,E,W)	Type	Filler	Fuse	Date Found	Disposal (BIP, PUCA Demo, EOD)	Date Disposed	Comments

SECTION 3

Geophysical Plan

3.1 OE/MEC Safety

OE/MEC may potentially exist in the survey area. Geophysical survey personnel are prohibited from touching, handling, moving, or investigating any item which resembles OE/MEC. They will immediately direct the attention of a qualified UXO supervisor or UXO technician. In the event that such an item is discovered outside of the controlled project boundaries or if no qualified UXO person is present, the survey personnel will conspicuously mark the location of the item (not the item itself) and immediately direct a UXO supervisor to the location. Survey personnel should not remain within 250 ft of any UXO item without the supervision of a qualified UXO supervisor.

Geophysical subcontractor personnel shall fall under the SSHP presented in Section 4 of this Work Plan.

3.2 Personnel Qualifications

The geophysical survey team will consists of the senior survey technician, who will be responsible for the data collection and processing, and one survey technician.

Geophysical data will be dumped and initially processed and evaluated on location by the senior survey technician. Post processing of geophysical data will be conducted from a fixed base location and will provide the necessary data from which targets can be selected for reacquisition and eventual recovery.

3.3 Geophysical Investigation Plan Outline

3.3.1 Site Description

Red Beach and Blue Beach consist of open beach areas and open access roads. The estimated sizes of the beach areas (including access roads) are 10 acres for Red Beach and 10 acres for Blue Beach (total of 20 acres of survey area). The geology is primarily beach and dune deposits made up largely of calcite, quartz and volcanic rocks, and fragment sand with local magnetite. Because of the proximity of the site to the ocean, shallow groundwater is expected to be mostly seawater.

3.3.2 Geophysical Investigation Program Objectives

The objective of this geophysical survey is to detect and map the locations of geophysical anomalies that may represent OE/MEC (nominally expected to be less than 1 ft below the surface (see Section 3.3.10, Soil Conditions).

3.3.3 Specific Area(s) to be Investigated

The digital geophysical survey is to be performed along Red Beach and Blue Beach as follows:

- Geophysical test plot (prove-out)
- Establish DGM control (Puerto Rico State Plane)
- 100 percent DGM, EM-61: approximately 20 acres beach and road areas
- Anomaly reacquisition

The subcontractor will first perform a geophysical prove-out to determine the optimum geophysical approach(es) for the range and to demonstrate the detection capabilities. It can be assumed the Navy will provide inert ordnance or equivalent shapes necessary for the prove-out.

Once the prove-out has been completed and accepted by CH2M HILL, the subcontractor will then perform an EM-61 survey in the 20-acre beach and access road area. The geophysical contractor will be responsible for removal of any obstacles needed to use their equipment in the beach and road area. The geophysical survey will cover 100 percent of the beach and road area (20 acres). For the beach and road area, all anomalies will be re-acquired for excavation to 1 ft by qualified UXO personnel.

3.3.4 Past, Current, and Future Use

The AFWTF provides facilities and schedules NGFS and ATG ordnance delivery training for Atlantic Fleet ships, NATO ships, air wings, and smaller air units from other allied nations and the Puerto Rican National Guard. The Fleet Marine Force, Atlantic, conducts training for Marine amphibious units, battalion landing teams and combat engineering units in the EMA. Occasionally, naval units of allied nations with a presence in the Caribbean and the Puerto Rican National Guard also utilize the EMA.

The training areas have been used continuously since World War II when the Navy acquired title to the land. Within the Inner Range, the Atlantic Fleet's ships, aircraft and marine forces carry out training in all aspects of NGFS, ATG ordnance delivery, air-to-surface mine delivery, amphibious landings, small arms, artillery and tank fire, and combat engineering. As part of normal operations, unexploded ordnance is periodically cleared from the AFWTF's "Inner Range" and destroyed by OB and OD at the Facility. Blue Beach and Red Beach were used for amphibious assault training exercises. Only small arms, blank cartridges, and possibly photoflash cartridges were used.

AFWTF operations have precluded outside development from occurring on the property and have resulted in the area remaining undeveloped. Before April 1999, public access to Red Beach and Blue Beach was allowed. Proposed future uses for the site include public beach access.

3.3.5 Anticipated OE/MEC Type, Composition, and Quantity

Suspected ordnance likely to be found include 5.56 mm to .30 caliber rounds. Photoflash cartridges (from as small as 2 inches in diameter and 4 inches long to as large as 4 inches in diameter and 18 inches long) also may be present at the site. Some of the photoflash cartridges could be non-ferrous material such as aluminum. The potential also exists for

smoke grenades to be encountered, based on the former use of the site for amphibious assault training exercises.

3.3.6 Depth Anticipated

The OE/MEC in this area could be at or near the surface or down to its maximum detectable depth. The following detection depth calculations are from formulae published by the Corps of Engineers, Engineering Manual 1110-1-4009, Ordnance & Explosive Response:

Ordnance	Min Dia (mm)	LOG Mag depth*	Mag Depth (m)*	LOG EM depth	EM depth (m)	Mag Depth (ft)*	EM depth (ft)
Photo flash, ferrous, 2 inches	51	-0.34295	0.45	-0.25001	0.56	1.49	1.84
Photo flash, ferrous, 4 inches	101.6	0.06233	1.15	0.04991	1.12	3.79	3.68
CONTROL CALCULATION	105	0.08169	1.21	0.06423	1.16	3.96	3.80

* Ferrous ordnance only

The non-ferrous “bakelite” photoflash cartridges potentially present in the survey area may be at or near the detection capability of available instrumentation.

3.3.7 Topography

Red Beach is composed of two separate beaches in Bahia Corcho, located approximately 1 mile directly south of the Camp Garcia compound. The main beach encompasses approximately 5 acres, and a second beach located 200 ft to the west encompasses approximately 4 acres. Both beaches are relatively wide (100 to 300 ft).

Blue Beach is long (approximately 4,000 ft) and narrow (50 to 200 ft) and is located approximately 1.5 miles southeast of the Camp Garcia compound.

3.3.8 Vegetation

Vegetation is not expected to be a concern for this assignment because the majority of the investigation will be conducted in open beach areas.

3.3.9 Geologic Conditions

Three major rock types in the upland areas and unconsolidated sedimentary deposits in the low lands generally characterize the geologic profile of Vieques.

The Red Beach and Blue Beach areas are characterized by unconsolidated sedimentary deposits of Quaternary age, which consist of alluvial deposits, beach and dune deposits, and swamp and marsh deposits.

3.3.10 Soil Conditions

Soils on Vieques Island are primarily residual, because of both climatic and subsurface rock conditions. The eastern side of the island has poorly developed soil because of the impermeable nature of volcanic rock and the nature of the climate on Vieques.

Soils on Vieques typically are classified into one of five groups. The first group is referred to as the Descalabrado series. This group accounts for 30 percent of the total land area on the island. This soil is shallow and well-drained, and typically very dark brown to dark grayish-brown. Grasses and shrubs are the only types of vegetation able to grow in this particular type of soil. Grazing, wildlife, and woodland are the only other uses for this soil. The second group is the Vieques series, which accounts for approximately 26 percent of the total land area on the island. This series is typically shallow, and is found in the upland regions of the island. The soil is dark brown in color, and has good drainage with moderate permeability. The third group is the Coamo series. This soil makes up approximately 16 percent of the total land area on the island. This soil is typically deep and well-drained in nature. The surface layer is very dark and slightly acidic to neutral. Agriculture can be maintained here along with xeric trees and brush. The fourth group is the Rock Land area. This area accounts for approximately 8 percent of the total land area on the island. This area is labeled Rock Land because rock outcrops occur and loose stones and boulders are common. Volcanic rock and limestone are the principal constituents of this area. Brush and shrubs are the only vegetation visible. The fifth group is divided into 11 additional categories, which together account for the remaining 20 percent of the land area: Ametia, Cartagena, Catano, Coastal Beaches, Descalabrado, Fraternidad, Jacana, Pandura, Paso Seco, Pancena, and Pozo Blanco.

Although ATG ordnance delivery and NGFS exercises are conducted on Vieques, soil conditions on the island have not been altered severely, because of the vegetation, soil, and surface drainage characteristics.

Geophysical Conditions. Magnetite (Fe, Ng [Fe2O4]), if present, should be in the form of individual, well-dispersed heavy mineral grains. The dispersed condition in the mechanically washed beach and dune deposits should prove to create a regional condition within the null capability of the EM-61. Beach and dune conditions where dark mineral grains are easily observed (without a hand loupe) should be subjected to geophysical prove-out qualification over seeded OE/MEC items.

3.3.11 Shallow Groundwater Conditions

Because of the proximity of the site to the ocean, the shallow groundwater is expected to be mostly salt water.

3.3.12 Site Utilities

No utilities are expected to be located within the geophysical survey area.

3.3.13 Man-made Features Potentially Affecting Geophysical Investigations

No significant man-made features are anticipated to be located within the geophysical survey area.

3.3.14 Site-Specific Dynamic Events Such as Tides, Unusually Strong Winds, or Other Unusual Factors Affecting Site Operations

No site-specific dynamic events are expected within the geophysical survey area or during the survey period.

3.3.15 Overall Site Accessibility and Impediments

The proposed method of site access to is the use of a four-wheel drive (4WD) vehicle along the road leading south from Camp Garcia. Passage over the beach areas will be via an all-terrain vehicle (ATV) or by walking.

3.3.16 Potential Worker Hazards

The potential work hazards derive primarily from two sources:

1. ATVs are unstable vehicles when used in an aggressive manner or on sloped areas. They are especially prone to roll over on slopes or at high speeds.

2. OE/MEC may potentially exist in the survey area. Geophysical survey personnel are prohibited from touching, handling, moving, or investigating any item which resembles OE/MEC. They will immediately direct the attention of a qualified UXO supervisor or UXO technician. In the event that such an item is discovered outside of the controlled project boundaries and/or no qualified UXO personnel are present, the survey personnel will conspicuously mark the location of the item (not the item itself) and immediately direct a UXO supervisor to the location. Survey personnel should not remain within 250 ft of any OE/MEC item without the supervision of a qualified UXO supervisor.

3.4 Geophysical Investigation Methods

3.4.1 Equipment

The geophysical survey will be a critical component of the assessment at Red Beach and Blue Beach, because the sites present unique challenges as a result of differences in target type, target depth, physical setting, and background.

3.4.1.1 Geophysical Sensors

One type of geophysical sensor technology will be used for locating OE/MEC at Red Beach and Blue Beach: electromagnetic instruments. Table 3-1 summarizes commonly accepted technologies and instruments. These instruments and their applications are discussed in the paragraphs following the table.

TABLE 3-1
Geophysical Detection Technologies and Instruments

Technology Type	Example Instruments	Data Collection Mode
Electromagnetic Instruments:		
Time-Domain Electromagnetic (TDEM)	Geonics Model EM-61 Geonics Model EM-61 Hand-held (HH) Geonics Model Mark II	Digital

Time-Domain Electromagnetics. TDEM metal detectors, such as the Geonics EM-61 device, are designed to detect shallow ferrous and non-ferrous metallic objects with very good spatial resolution and with minimal interference from adjacent metallic features. An EM transmitter generates a pulsed primary magnetic field in the earth, which induces eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field measured by the receiver coil of the EM-61. By taking the measurement at a relatively long time after the start of the decay, the current induced in the ground has fully dissipated and only the current in the metal is still producing a secondary field. The responses are recorded and displayed by an integrated data logger.

The system consists of two air-cored, 1-meter (m) square coils. Secondary voltages induced in both coils are measured in mV. The coils are stacked 40 centimeters (cm) apart, with the source / receiver coil ("B" – bottom coil) located below a second receiver coil ("T" – top coil). The EM-61 records a voltage output from both coils (Channel B and Channel T data), as well as a differential (Channel D) that is the calculated voltage difference between the two coils. The bottom coil data is generally most useful for detecting ordnance-size buried metallic objects. Three modes of operation are available:

1) Trailer mode, in which the coils are carried on a wheeled cart

2) Harness mode, in which the operator carries the coils on a shoulder harness

3) Array mode, whereby two coil systems are ganged into an array for high-productivity coverage. The electronics, battery, and an integrated data logger are carried in a small operator backpack.

Spatial positioning of the EM-61 data can be achieved in four separate ways: via GPS, ultrasonics, tick-wheel, or fiducial marks. GPS is the primary navigation choice, and is used when the EM-61 is deployed in the trailer mode or array mode. Once-per-second GPS coordinates are logged that capture the location of the GPS antenna co-located at the center of the EM-61 coil. When GPS is not practicable, an internal survey tick-wheel can be used for both trailer and array mode. In this case, the distances along profile lines are recorded as the sensor(s) are moved forward. Tick-wheels are appropriate as a backup to GPS or when GPS technology is adversely affected by local vegetation / topographic conditions. Navigation via fiducial time marks can be utilized when the EM-61 is deployed in a harness mode while the EM-61 data are recorded at fixed time intervals. In wooded conditions where GPS, tick wheels, and fiducial methods are not practicable, ultrasonic techniques provided via the USRADS technology are utilized, as discussed below.

The EM-61HH, similar to the EM-61, is a TDEM metal detector that uses a single transmitter coil and a single receiver coil. The coils are 18.5 cm in diameter and are located approximately 6 inches above the ground surface, when mounted on the wheel assembly. The EM-61HH can be operated with or without the wheel. Without wheels, the detector is used in a sweeping mode in front of the operator where the detector collects readings at automatic time rates. With the wheel assembly, the operators push the detector in a more controlled in-line operation and position the data via a tick-wheel. In the wheel mode, the data collection rate can be adjusted to collect readings at every 0.1 m or 0.2 m. The EM-61HH records two time-integrated voltage responses, one at an early time and one at a late time during the decay of the secondary magnetic field. The late time data is advantageous

for eliminating responses from very small metallic objects, because their signal will decay in time beyond detection. In general, because of the coil size and design of the instrument, the EM-61HH's near-surface sensitivity to small shallow objects is greater than that of the EM-61, and for larger items at depth its sensitivity is less. The EM-61HH requires closer survey line spacing than the EM-61 to achieve similar coverage. The line spacing for the EM-61HH should be 1 to 2 ft, depending on the size of the suspected targets. The line spacing would be the only operational change with regard to the grid layout. The functions of the EM61-HH for data collection and data output are identical to the EM-61.

3.4.1.2 Geophysical Prove-out

A geophysical prove-out will be performed to determine which instrument performs the best at Blue Beach and Red Beach. The test plot will be sited and OE/MEC items (or surrogates) will be seeded at depths ranging from 2 inches to 12 inches to represent expected site conditions as nearly as possible. The test plot will be surveyed with an EM-61 and a Mark II (or equivalents). The data for both instruments will be analyzed and submitted for approval by the project and site manager.

3.4.1.3 Geophysical Navigation Methods

A suite of navigation options is required to effectively collect sensor position data within the wide variety of vegetation and topographic conditions where DGM may be required. Additionally, the range in number, type, and depth of potential OE/MEC at those sites requires navigation accuracy of 20 cm. To respond effectively to the diverse set of navigation needs, four types of navigation technologies are utilized.

- GPS
- Acoustic/ultrasonic methods
- Fiducial methods
- Tick wheels

GPS. Advanced differential GPS technologies provide the sensor locations at half-ft, real-time accuracy. NAEVA will utilize the dual frequency, dual code, Trimble RTK differential GPS for field-mapping applications when satellite visibility conditions are adequate. Additionally, the subcontractor will deploy the single frequency, dual code, Trimble Pathfinder XRS equipped with multi-path rejection technology. This technology is favored in lightly wooded and congested areas where GPS signals are affected by multi-path reflection. GPS technologies offer full integration with geophysical sensors, real-time differential solutions based on either satellite-provided or base station-provided differential corrections, and the "multi-path rejection" capability that enables GPS positioning in tree-covered sites or near buildings.

Several site-specific issues must be resolved before GPS can be used reliably onsite. These include definition of the site-specific coordinate system on all navigation equipment, establishment of a differential GPS base station, establishment of methods to utilize real-time differential corrections over large sites, and complete testing of site-specific considerations.

In addition to mapping geophysical data, CH2M HILL uses GPS for many different OE/MEC mapping-related tasks, including:

- Feature identification: GPS is used to augment geophysical data and improve effectiveness of geophysical mapping through capture of visual observations made during a site walk-over. During this process, GPS plays a key role in position-stamping debris piles, unidentified fences, soil changes, vegetation, burn areas, craters, etc.
- Grid corner locations: GPS is used to mark survey grid corners.
- Target relocation: GPS equipped with targets loaded from the project GIS will be used for target relocation.

When GPS is determined to be appropriate for sensor navigation, the availability of sufficient satellite coverage will be determined prior to deployment to the site. Two factors dictate sufficiency of satellite coverage: the view of the sky from the survey site, and the number and height of GPS satellites above the survey site. Access to a clear view of the sky is affected by tree coverage, proximity to buildings, and topographic features such as cliffs and steep hills. The orbits of the GPS satellites can be readily viewed through use of GPS planning software such as Trimble SATVIZ. By reviewing the satellite availability on a daily basis, optimal survey periods can be defined, and periods of poor satellite visibility can be coordinated with rest times, preventive maintenance, data downloading, and travel.

GPS is used for geophysical mapping by deploying a rover receiver in conjunction with the geophysical sensors. Concurrently, a second receiver is established as a static base station over a known survey point. While the rover unit logs data with the sensors, the base station unit logs data for post-processing.

To achieve the required 20 cm accuracy, differential corrections must be applied to the GPS data. These corrections compensate for slight timing errors in GPS data associated with atmospheric affects on GPS signals. Three sources of real-time differential correction are available, including:

- Coast Guard broadcasts (where available, typically near the coast and major waterways)
- Satellite-based subscription services (such as OMNISTAR)
- Onsite base stations

Acoustic/Ultrasonic Methods. Acoustic/ultrasonic navigation methods represent an accurate alternative for precision sensor location under conditions where GPS is not applicable. In particular, acoustic/ultrasonic methods are used for geophysical mapping under tree canopies where continuous line-of-sight to the GPS satellites is obscured. NAEVA will employ USRADS, manufactured by CHEMRAD. USRADS is an active spread-spectrum system that utilizes pre-placed transponder beacons to survey in wooded areas. The USRADS technology is fully integrated with magnetometer, gradiometer, and electromagnetic sensors and generates data in state plane coordinate systems. The sensor package can be deployed as a backpack, cart-based, or vehicle-towed configuration, and can be used in data collection or target relocation modes. Data can be collected via USRADS for grid, transect, and full converge modes.

Fiducial Methods/Tick Wheels. Fiducial methods and tick wheels represent less accurate navigation methods that can be used in cases where primary navigation methods (GPS and/or ultrasonic technologies) prove impractical. CH2M HILL will only deploy these technologies if the primary methods are not useable. Fiducial methods use a time-marking

procedure to determine the spatial location of the collected data. Using this approach, a series of survey lanes are established over a grid. Flags are placed at the beginning and end of each lane and an operator walks down the lane while the data logger collects sensor readings at a prescribed sampling rate (10 times per second, for example). As the operator walks past the starting and ending points in the survey lane, he or she hits a button on the data logger that places a fiducial time mark in the data stream. By assuming the operator walked in a straight line at a constant velocity, the location of each data point can be estimated. Under good conditions, accuracy levels of 10 cm can be achieved.

Tick wheels employ a methodology similar to that of fiducial markers to determine the location of collected sensor readings. Tick wheels are integrated with a data logger and mechanically programmed to initiate a data recording sequence after a pre-set forward distance is traversed. For example, the EM61 can be programmed to collect data every 1 ft of forward distance. As with fiducial methods, accuracy levels of 10 cm can be achieved if good conditions exist at a site and if the operational assumption of a straight-line path is not violated.

3.4.1.4 Geophysical Survey Modes

A wide variety of survey modes can be utilized to collect geophysical data for the detection, location, and characterization of OE/MEC. These modes include:

- Full surveys
- Grid surveys
- Transects
- Meandering paths
- Hybrid surveys

The most appropriate survey mode is dictated by several factors, including topography, vegetation, and the number, type, and distribution of OE/MEC. Additionally, the most effective survey mode is dependent on the objectives of the survey. For example, if a site is being remediated, then it may be appropriate to conduct a full survey. Alternatively, if a site evaluation is being performed, then random grids, transects, or meandering paths may prove more effective.

Full Coverage Surveys. Full coverage is used when an entire site requires OE/MEC detection, location, and characterization. Under this methodology, the site is evaluated prior to deployment to determine the most effective strategy of data collection. The site data for the AFWTF and EMA will be employed to review site conditions, including site topography, vegetation, proximity to structures (pipelines, fences, etc,.), and other site conditions that may affect access or sensor performance. Full coverage can be achieved through deployment of the sensor system in a variety of techniques, including subdivision of the site into a grid mosaic or collection of parallel survey lines. All data traverses are brought into the GIS for verification of full coverage.

The investigations at Blue Beach and Red Beach will use the full coverage survey mode to fully characterize the open beach area and beach access roads to the 1 ft clearance depth.

Grid Surveys. Grids are used to survey discrete rectilinear parcels either as part of clearance or evaluation activities. Typically square, grids are usually 100 ft on edge (10,000 sq ft or

approximately 0.23 acres) or 200 ft on edge (40,000 sq ft or 0.92 acres). If logistically practical, grids are aligned in a north-south / east-west orientation to simplify the processing of the collected data. Two types of grid surveys can be used; fixed pattern grid sampling and random pattern grid sampling, as described below

Fixed Pattern Grid Sampling. Fixed Pattern Grid Sampling is the process where grids are laid out in a pattern on a fixed percentage (often 10 percent) of a sector. Fixed Pattern Sampling is not commonly used since other more random patterns can provide statistically valid results using fewer grids.

Random Pattern Grid Sampling. Random pattern grid sampling uses a statistical approach to place grids randomly throughout a sector. The total area to be sampled is first determined using a statistical process such as OE/MEC calculator (a software package used to calculate projected OE density). Grid size and shape is then determined based on site terrain, vegetation, and the geophysical instruments to be used. Grids can be any convenient shape, but square or rectangular grids are used most often. Grids do not need to be the same size and can be as small as 2,500 sq ft, or as large as 1 hectare. Since random sampling grids are placed completely randomly, large unsampled areas can remain within a sector. For this reason, purely random pattern sampling is not recommended.

Transect Surveys. Transect surveys are utilized to evaluate the extent of contamination in a large area through systematic surveying along linear paths. For example, to estimate the extent of contamination associated with a known impact area, transect survey lines can be collected radially outward from the known contamination area. Subsequent analysis can define the approximate limits of the contamination. Similarly, transects can be utilized in a rectilinear pattern to search large areas. These "pattern searches" can be employed to locate large features such as OB/OD sites and landfills, or to statistically evaluate the OE/MEC contamination within a large site. Transect offset patterns and swath widths are dictated by the site-specific objectives of the survey.

Meandering Path Investigations. Meandering path surveys are effective for statistical evaluation of OE/MEC contamination. Under this approach, semi-random traverses are executed within pre-defined boundaries of an investigation site. The operator deploys sensors in a random walk to collect statistically random data from a site. An advantage of the meandering path approach compared to grids or transect surveys is the flexibility afforded to the operator to make minor real-time path adjustments to avoid problematic survey areas (trees, bushes, ravines, etc.). As such, this method allows statistical sampling without significant brush cutting. Meandering paths are inherently random and not pre-planned. However, the general area for the survey is defined in the GIS prior to deployment.

Hybrid Sampling Surveys. To ensure that a sector receives thorough sampling grid coverage, and that areas known or suspected to contain OE/MEC are geophysically investigated, a modified version of random pattern sampling is recommended. In this hybrid approach, grids are placed randomly across the sector as described previously. Afterward, however, approximately 20 percent more grids are placed in biased locations to fill any apparent data gaps. This approach is recommended when sampling grids are used.

Mag and Flag Survey Procedures. Mag and Flag surveys will be performed only when DGM is determined to be impractical or ineffective. The use of Mag and Flag procedures will be

determined on a site-by-site basis, and will not be used as the primary methodology for OE/MEC detection.

Mag and Flag surveys will be performed using Schonstedt magnetometers (see Section 3.4.1.1) according to the following procedures:

1. The UXO Technician III will oversee the division of the survey area into 10-ft-wide search lanes, which will allow UXO technicians to perform 5-ft wide sweeps in two passes. Wooden stakes will be driven into opposing ends of the survey area boundary every 5 ft. Surveyor's line will then be strung between opposing stakes to form the easily definable search lanes.

2. Under the supervision of the UXO Technician III, operators will systematically and thoroughly survey assigned search lanes using the highest sensitivity setting of the instrument. The operator will slowly move forward along the search lane, sweeping the instrument from side to side, and making sure the entire width of the search lane is swept. As anomalous areas are encountered, the magnetometer will generate a change in aural tone that is indicative of a metallic object. The operator will further refine the position of anomalous areas by observing the peak aural tones as the magnetometer is moved over the anomalous locations.

3. The operator will place a pin flag in the ground where the aural tone is the highest along intersecting perpendicular sweeps.

4. The operator will continue in this fashion until the search lane is completed.

5. After all lanes are surveyed, the geographical coordinates will be determined and recorded for each pin flag.

3.4.2 Geophysical Team Members and Qualifications

The geophysical survey team will consist of a geophysics survey technician, who will be responsible for the data collection and processing, and one project geophysicist who will be responsible for evaluating the data. Qualifications for Geophysical contractors should be based on experience and the ability to perform the functions in CEHNC DID OE 005-05, CEHNC DID OE 005-07, and the CH2M HILL OE Master Work Plan (CH2M HILL, October 2001).

3.4.3 Production Rates

Geophysical mapping production rates are highly variable and depend on several factors, including topography, vegetation, site access, proximity of survey area, and weather conditions. Additionally, the selection of the sensor suite (sensor type and array configuration), defined by the expected type, number and distribution of expected UXO and local soil conditions, affects productivity. For example, in open areas with little vegetation, magnetometer systems deployed as ganged arrays can out-perform TDEM sensors in terms of area covered per day.

Another factor that impacts productivity is the mode of survey selected. Full coverage surveys are the most efficient as they require the least set-up time, whereas small grids are less efficient. Specific production rates will be determined on a site-specific basis.

3.4.4 Data Resolution and Data Density

OE/MEC items are detected, located, and characterized through the collection and analysis of data containing a geophysical signature of the buried target. The signature must have enough signal strength to allow for clear and unambiguous detection, and must have sufficient signal fidelity to allow for the recognition of the anomaly as potential UXO. As such, the resolution of the target is based on the following factors:

1) The type, number, and expected distribution of potential OE/MEC
2) Existence of possible debris, and/or metal structures that may complicate or obscure the geophysical anomaly
3) The type of sensor deployed
4) The height of the sensor off the ground

Three adjustments to the data collection systems can be made to assure that sufficient data resolution is achieved. First, the sensors can be deployed as ganged multi-sensor arrays with the offset of the sensors adjusted to establish sensor spacing. Second, the line-spacing can be adjusted to establish inter-sensor offsets. Third, the data collection rate can be adjusted to increase (or decrease) collection of data in the forward-moving direction. Data collection rates are varied by adjusting the number of samples collected per second (for GPS, ultrasonic, and fiducial methods) or by adjusting the spatial data-collection interval of the tick-wheel. The specific data resolution and data density requirements will be established on a site-specific basis.

3.5 Instrument Standardization

3.5.1 Instrument Drift

Geophysical instruments facilitate detection of subsurface targets by measuring anomalous readings caused by the targets relative to a background level. These geophysical anomalies are the basis of OE/MEC detection. If the background level of an instrument varies over time (drifts), then the capability to detect anomalous features in the data associated with buried targets is diminished. As such, all instruments require calibration of the background instrument level.

Instrument drift will be measured by recording data over conveniently located areas known to be free of subsurface geophysical anomalies. These drift calibration areas will be defined by surveying the site with geophysical sensors to locate a parcel with no measurable anomalous geophysical features. Once established, each sensor will record data over the site in north-south and east-west transects at least twice per day, once before any field data are collected and once after all data are collected. These data will be downloaded and reviewed by the Project Geophysicist on a daily basis to determine whether drift correction adjustments are required in any of the collected field data.

Data from the diurnal base station are downloaded daily and utilized during the data processing step to adjust the survey data for fluctuation in the earth's magnetic field.

3.5.2 Standardization Procedures

Just as the effects of sensor drift require quantification to allow for effective geophysical mapping, sensor standardization is also required to ensure collection of accurate and repeatable OE/MEC target signature data. The objective of standardization procedures is to determine whether each deployed sensor is operating adequately within the sensor performance specification. To ensure that each data collection activity results in repeatable data, the following steps will be executed:

- Instrument serial numbers will be recorded in field logs.
- Personnel will be checked for metallic objects prior to survey commencement.
- Wiring will be secured to the transport structure to minimize noise directly from the instrument.
- Azimuth measurements will be made to determine any dependence of the measured signal on azimuth and corrections will be applied to measurements obtained along different azimuths, as necessary.
- Navigation instrumentation will be calibrated over a known monument and recalibrated over a known point daily.
- Instrument calibrations will be performed, recorded, and logged each morning and evening over a known source to insure that instrument functionality is maintained within the required specifications of repeatability.
- Individual measurements will be compared to the locally obtained statistical baseline information to determine the normal operating range and deviations that constitute failure.
- System timing delays will be determined from the calibration data and corrected to insure accurate positioning.
- Tick wheel operation and/or fiducial marks will be used as a primary or back-up method of positioning when GPS or acoustic methods cannot be applied or fail in the field.
- Instrument transport structures will be maintained level to ensure consistent positioning and data.
- During grid operations, the first and last lines will be repeated in opposite directions to ensure instrument and data quality.
- GPS features will be recorded for each individual grid and meander path to serve as a backup record independent of the field log and field maps.
- Field geophysicists and instrument operators will continuously check instrument readouts and audio alerts to ensure proper operation.

Standardization procedures are modified on a site-specific basis to maximize efficiency and to adjust to logistical and schedule requirements.

3.5.3 Abbreviated Standardization Checks

Standardization for geophysical mapping is ensured through adherence to standard procedures and full documentation. The following are logs used to maximize sanitation, repeatability, and control of mapping activities:

- Crew Deployment Log: This log defines the location of each geophysical survey crew on a daily basis. The log tracks crew members, equipment, and the expected area to be surveyed. Attached to this daily log are maps of the areas to be surveyed containing the coordinates of benchmarks in the areas as well as the coordinates of each quadrant corner.
- Field Log: This log is filled out by each crew chief and details all activities of the survey. This is a daily log and contains observations about crew performance, sensor performance, site conditions, soil conditions, and weather changes.
- Instrument Calibration Log**:** This log documents the daily calibration of each field instrument. Daily calibration procedures are executed for each geophysical and navigational instrument. The sensor system is brought to a calibration area before each survey day starts and the background magnetic field and the magnetic field signal from a reference target are measured and recorded.
- Data Control Log: Kept in the office trailer, this log tracks all data flowing in from the field and out to the office. Data include all geophysical field data, calibration data (via Calibration Logs), all field notes from field logs, and all GPS quadrant coordinate data. This log tracks the GIS system electronically, with hard copy prints made daily.
- Data Processing Log: All magnetometer data from the field are run through a standard data processing procedure. This procedure is the same for all data and is tracked with the data processing log. This log documents all coordinate transformations, visual data quality checks, statistical data quality checks, survey coverage statistics, interpolation parameters, etc.

3.5.4 Instrument Response to a Known Standard

Geophysical instruments used for mapping activities, anomaly reacquisition, hole clearance, and QC will be field-tested daily to ensure that they are operating properly. The Project Geophysicist, in consultation with the LANTDIV, will establish standard calibration lines over known inert OE/MEC items buried in a test grid. If the standard indication cannot be attained, the instrument will be re-calibrated, repaired, or replaced.

- The function of each geophysical instrument will be checked according to the manufacturer's specifications upon daily checkout by the survey teams.
- Each digital geophysical instrument will measure and record two standard calibration test lines over known inert OE/MEC items each morning prior to use. Peak anomaly readings over the OE/MEC items within 10 percent of the known values will be considered to indicate that the instrument is functioning correctly.
- Each digital geophysical instrument will measure and record two standard calibration test lines over known inert OE/MEC items at the end of each day and at any other time

at the discretion of the instrument operator or the Project Geophysicist, to assess instrument functionality and drift.

- Analog geophysical devices will be tested at the beginning and ending of every work day over the standard calibrations. If an audible response is not achieved over each known buried OE/MEC item, the instrument will be re-calibrated, repaired, or replaced as necessary.

3.6 Data Processing: Correction and Analysis

OE/MEC geophysical data analysis begins after execution of standard data processing steps in which field data are verified, cataloged, reviewed, and converted into interpolated grid files in state plane coordinates.

Geosoft's Oasis montaj™ UX-Detect software and onsite Surfer (a software packaged by Golden Software) or another suitable software approved by NOSSA, will be used to analyze and interpret the collected geophysical survey data. This software facilitates interpretation of digital magnetic and electromagnetic data sets. Output from this analysis will be used to identify any anomalous areas that require further investigation. The final geophysical data set will then be provided to LANTDIV for independent interpretation/evaluation.

Analysis of geophysical data includes the following procedures, all of which are documented in the data processing log:

- Initial data review
- Specialized filtering
- Target detection
- Target analysis
- Analysis review

3.6.1 Initial Data Review

One-dimensional data (from transects and meandering paths) and two-dimensional data (from grids and contiguous surveys) will be reviewed for accuracy, completeness, and data fidelity. Grid data will be loaded in the project GIS for comparison with cultural features that exist within the GIS. Additionally, the initial review in the GIS allows the operator to examine the data with respect to the visual features observed onsite and captured via GPS. The operator will examine the quality of the data and define additional filtering or re-processing of the data that may be necessary. The operator will validate that the data are complete and that the data fall within the prescribed grids bounds.

Additionally, one-dimensional line data will be re-reviewed in Geosoft's Oasis montaj™ UX-Detect software, which has a profile display mode. All observations related to data review will be fully documented in the data processing log.

3.6.2 Specialized Filtering

Geophysical data sets may require additional processing to extract the maximum amount of information about subsurface targets. This filtering process is an important component of the analysis because it allows low amplitude signatures to be accentuated and low-relief

targets to be detected. Filters are applied to minimize noise and reduce effects of geologic trends and adverse soil conditions. The resulting filtered grids will be analyzed in the Geosoft Oasis montaj™ UX-Detect software system by a trained operator to identify more subtle targets possibly missed in the standard approach.

3.6.3 Target Detection

Targets are detected in a two-step process:

1) Initial automated detection
2) Operator-aided detection by a qualified geophysicist

The first step is automated target detection based on threshold analyses. Geosoft's Oasis montaj™ UX-Detect is used for simple threshold detection and is augmented by in-house methods utilizing a region-growing algorithm for more sophisticated auto detection and feature extraction. Parameters controlling the selection of targets include proximity of adjacent targets, signal power density, collocation of targets on other channels of data, areas size, and distribution of anomaly amplitudes.

The second step is manual detection of targets based on systematic visual search of raw and filtered data, on single or multiple channels. This is accomplished within the Geosoft Oasis montaj™ UX-Detect software system. At this stage, automatic target detections are modified, deleted and/or added to by the operator. The automated and operator target detection steps result in a target list and a set of target parameters, including X, Y, area, semi-major length, semi-minor axis length, proximity to other targets, and signal strength statistics.

3.6.4 Target Analysis

Detected anomalies will be analyzed to estimate target parameters including Easting, Northing, depth, and mass. Two different analysis methods, based on analytical models and empirical models, will be used to characterize the targets and are employed depending on the type of data collected. GeoSoft Oasis montaj™ UX-Detect software is used with total field magnetometer for mass and depth characterization based on a two-dimensional Euler deconvolution algorithm that calculates the apparent depths and weights of selected magnetic targets. The apparent depth to the magnetic source is derived from Euler's homogeneity equation, which relates the magnetic field and its gradient components to the location of the source of an anomaly, with the degree of homogeneity expressed as a "structural index." Additionally, a magnetic dipole model is employed to estimate target depth and magnetic moment through an iterative least-square model-matching algorithm. Magnetic moment is related to ferrous mass through an empirical relationship. For electromagnetic data, empirical relationships based on the signal strength and spatial extent on both channels of the EM-61 sensor are used to estimate target mass and depth.

In addition to these methods of target analysis, the operator uses a signature database to review the algorithm-based results. In this process, each target is reviewed relative to target signatures of known items buried at known depths and orientations. Additionally, as excavation ground-truth data is acquired during OE/MEC removal, the information is fed back to the Project Geophysicist and incorporated within the project site OE/MEC target signature database. Through this process, knowledge base project site signatures increase, and the effectiveness of data analysis improves.

3.6.5 Analysis Review

Review of data analysis consists of five steps. First, a review is performed of all entries in the data processing log that track both the chain of custody of the data and all numerical procedures that have been applied to the data. Second, 10 percent of all data are reprocessed and re-analyzed to ensure replication of the results. Third, all target detection data are reviewed by a second qualified geophysicist. Fourth, all target detection and geophysical data are reviewed within the project GIS to ensure that no cultural features are masking potential new targets, and that no detected targets are actually cultural features. Fifth, the results of all excavation activities are fed back to the Project Geophysicist for confirmation of excavation. Under this process, all ground-truth data is checked to make sure that the item removed during excavation is of a size, type, and orientation consistent with the recorded data.

3.7 Quantitative Interpretation and Dig Sheet Development

The target analysis process culminates in the creation of dig sheets, which contain target location, depth, and weight estimates. The dig sheets will also contain listings of the peak raw amplitudes recorded on sensors and the distance from the peak amplitude to the 50 percent amplitude level. These amplitude values are used to verify that the correct target is excavated.

For each grid, the geophysical subcontractor will assess each of the following factors prior to generating an anomaly list:

- The local background conditions of the magnetic, gradiometric, or electromagnetic response
- Data completeness and accuracy
- Data quality based on the survey and grid QA data
- The grid boundary conditions, utilities and / or other cultural features present, and unsurveyable areas (beneath roads, trees, buildings, etc.)
- A delineation of the extent and boundaries of metal-rich landfill areas, if any (Anomaly lists will not be generated for metal-rich landfill areas)

The criteria for selecting and locating anomalies for the anomaly list include the following items:

- The maximum amplitude of the response
- The maximum amplitude of the response with respect to local background conditions
- The lateral extent (plan size) of the area of response
- The three-dimensional shape of the response
- The location of the response with respect to the edge of the grid, unsurveyable areas, land features, cultural features, or utilities within or adjacent to the grid

- The shape and amplitude of the response with respect to the response of known targets buried in the geophysical prove-out test plot
- The shape and amplitude of the response with respect to relevant anomalies encountered in previous OE/MEC removal grids
- The apparent depth of the anomaly
- Potential distortions in the response due to interference from nearby cultural features
- Supplemental analysis of the top coil or differential data as necessary
- Any instrument or grid survey QC that could affect the analysis

The Site Geophysicist will analyze the geophysical data for each OE/MEC removal grid, identify anomalies that may represent buried OE/MEC, and prepare anomaly lists containing the following information:

- Project site
- Geophysical contractor
- Responsible geophysicist
- Grid identification
- Grid corner locations in state plane coordinates
- Grid background response levels
- Unique anomaly identification numbers
- Predicted anomaly easting and northing in both local grid (relative) coordinates and in state plane coordinates
- Instrument peak value at each anomaly location

The anomaly lists will be prioritized; anomalies deemed more likely to be OE/MEC will be ranked higher than anomalies less likely to be OE/MEC. A proposed grid-specific "cut line" for preparation of the dig sheet will also be provided. The dig sheet will be of a subset of the anomaly list. Anomalies below the "cut line" generally will not be excavated unless warranted by field conditions. Each anomaly list submitted to LANTDIV will be accompanied by a proposed "cut line," separating the recommended dig locations from the anomalies unlikely to represent OE/MEC. The "cut line" for each grid will be established based on the site conditions for each OE/MEC removal grid. Based on its QA review, LANTDIV may accept or adjust the "cut lines," or add additional dig locations prior to accepting a final dig list for each OE/MEC removal grid.

3.8 Anomaly Reacquisition

Before intrusive activities can be performed, the geophysical anomalies identified on the digital geophysical surveys must be reacquired. Anomaly reacquisition is a two-step process. The first step is to locate the ground position of the anomaly coordinates as

specified on the dig sheet. This will be performed using differential GPS, conventional survey methods, or measuring tapes, based on local site conditions. A white non-metallic pin flag, labeled with the unique anomaly number, is placed in the ground at the indicated grid coordinates. The second step is to use the same instrument used to detect the target (type of electromagnetic sensor) to identify the peak location of the anomaly, the precise location on the ground where the excavation should occur. The sensor will be moved back and forth over the general area of the anomaly coordinates until the peak value of the anomaly is located. If more than one peak is located, the peak with the highest amplitude will be selected. If no unique peak value is present (i.e., the same peak value is measured over an area), the center of the maximal area will be selected. If no peak value is located at the indicated location, the white anomaly location flag will be left in place and the Project Geophysicist will be consulted.

The peak value measured over the anomaly will then be recorded and the dig location will be marked with a colored flag labeled with the anomaly number. The specified relocation process serves three purposes:

1) It focuses the excavation over the actual anomaly peak, instead of an interpolated location between the survey measurement points.

2) It reduces measurement errors.

3) It provides a quality control ground check for the dig locations.

All discrepancies between the dig sheet location and the actual reacquired location, and any anomalies that could not be reacquired, will be recorded. The reacquisition location will be measured and logged. The reacquisition coordinates will be used as the official dig location for location quality control assessment.

3.9 Feedback Process

The feedback of ground-truth excavation data is one of the most important ways to ensure efficient and effective OE/MEC geophysical mapping. Excavation data collected during each intrusive activity will be captured to document the item location, weight, shape, orientation, and depth. This data will be electronically entered into a ground-truth database and incorporated within the project GIS.

The feedback process will also populate the database developed for each target signature developed during the data processing and analysis steps. The Project Geophysicist will review the target signatures in conjunction with the integrated ground-truth data to evaluate local geologic/geophysical effects on the target signatures. This information will be described in weekly reports and be communicated to the staff processing and reviewing geophysical data.

Excavation results for each OE/MEC removal grid will be posted on the project-provided internet web site within approximately three working days of grid completion. The Project Geophysicist, or a designee, will review the excavation results with respect to the anomaly selection criteria, "cut-line" level selection, QC dig results, actual OE/MEC encountered, and any performance criteria failures, and will provide a weekly progress report with recommendations to LANTDIV.

3.10 Quality Control

Geophysical mapping QC will be defined on a site-specific basis and will be dictated by the sensors, navigation methods, survey modes utilized to achieve the site-specific objectives. The following QC steps, however, will be incorporated into all site-specific plans:

- Daily pre- and post-operation instrument calibrations to ensure readings within manufacturer's specifications
- Digital capture of data over standard calibration response objects with 10 percent variation threshold
- Navigation calibration via twice-daily acquisition of survey benchmark locations
- Target reacquisition accuracy testing via repetitive acquisition of selected anomalies
- Post-operation equipment checks to ensure that equipment is serviceable, with damaged or malfunctioning gear identified. Equipment maintenance program will include preventive and corrective response measures.
- Independent review of raw and processed data via OE/MEC QC Analysts. All dig sheets will be reviewed by two qualified geophysicists prior to intrusive activity.
- Audits of field procedures with defined pass/fail criteria and defined corrective measures
- Defined records management and review procedures
- Selection of additional targets not initially selected for dig sheets. Selecting additional targets numbering 10 percent of original list verifies false alarm reduction techniques.
- Random sampling of completed grids. QC specialist performs hand-held mag or EM sweep identifying metal debris. Targets numbering 10 percent of detected targets will be selected for excavation to validate discrimination methods. Results will be reported to Project Manager and corrective actions will be identified.
- Confirmatory excavations. Upon LANTDIV concurrence, small sub-grids (e.g., 100 sq ft) will be fully excavated to prescribed depths. Spoils will be checked to ensure 100 percent OE removal. Results will be reported to Project Manager and corrective actions will be identified as needed.
- Comparative review of intrusive results. Excavation results will be reviewed by Site Geophysicist ensuring that excavated anomalies correspond to the selected targets. The size, depth, and orientation of each target will be compared with digital data identifying possible mis-matches. All suspect intrusive results will be reinvestigated.
- Comprehensive digital documentation of site activities with in-place feedback procedures to capture lessons learned. Daily "lessons-learned" will be a component of morning safety tailgate briefings.

After each excavation is completed, the field crew will collect a target signature over the excavation area in an "X" pattern. The crossing profiles will be at least 20 ft long and will be

collected in the north-south / east-west directions. This post-excavation data will be supplied to the Site Geophysicist for review. The purpose of this data collection is to validate and verify that after the excavation is completed, no additional anomaly associated with an additional target exists at the excavation location.

The raw and processed geophysical survey data, replicate and other QC data, field notes, data processing parameters, maps, anomaly lists, and proposed "cut lines" for each OE / MEC removal grid will be provided by the geophysical subcontractor to the Project Geophysicist, or his designee, for QC review. If acceptable to the project team, the data will be considered to be in draft form and will be provided to LANTDIV for review at least 2 weeks prior to planned intrusive activities in that particular grid.

A QA review of the data and proposed dig lists will be performed by LANTDIV. Selected geophysical data and target lists may also be reviewed by other designated QA parties. The Project Geophysicist or a designee will address comments received from any review, and responses will be submitted to the LANTDIV. Upon acceptance of comment responses by the LANTDIV, the geophysical data, maps, and dig list will be made available for use by the UXO teams.

QC audits, to ensure that the overall QC procedures and objectives of the project are met, will be performed at the discretion of the CH2M HILL Project Manager.

3.11 Corrective Measures

Specific corrective measures dependent on the type of geophysical equipment used during an operation and will be developed on a site-specific basis. The following basic corrective measures, however, are employed by CH2M HILL for digital geophysical mapping:

- Replacement of sensors if they fail to meet calibration requirements
- Replacement of navigation equipment if daily checks of location accuracy are not met
- Re-survey of grids when data quality specification are not met
- Re-processing of all geophysical data collected during a survey day if 10 percent re-processing procedures result in detection of additional valid targets
- Re-excavation of targets if Project Geophysicist determines that the excavated targets are not associated with the initial target anomaly

3.12 Records Management

CH2M HILL will establish a geophysical records management plan upon issuance of site-specific task orders. The following items will be contained in each plan:

- **Field survey records management:** All data files and field logs generated during the filed operation will be managed by the Project Geophysicist. Paper files will be organized in the office trailer and filed by individual day. Photocopies of all paper documents will be made and filed at an offsite location. Electronic files will be organized on an office PC dedicated to geophysical investigation management. Electronic files

include, but are not limited to: magnetometer files, gradiometer files, EM61 sensor files, diurnal base station files, rover GPS files, base station GPS files, sensor calibration files, and drift correction files. File directory structures will be organized by day-of-year, with subdirectories for specific field activities (GPS data, survey data, etc.). All field data will be backed up onto CD ROM or tape on a daily basis, and will also be transferred to an offsite CH2M HILL location.

- **GIS records management:** All generated and developed GIS files will be managed by the GIS Specialist and stored on an onsite PC dedicated for GIS management and analysis. The data will be stored within the standard GIS sub-directory structure with "README" files in each directory containing a description of the contained files. All GIS data will be backed up onto CD ROM or tape on a daily basis, and will also be transferred to an offsite CH2M HILL location.
- **Data processing and analysis record management:** All data files and data processing logs generated during the processing and analysis of geophysical field data will be managed by the Project Geophysicist. Paper files will be organized in the office trailer and will be filed by individual day. Photocopies of all paper documents will be made and filed at an offsite location. Electronic files will be organized on an office PC dedicated to geophysical investigation management. File directory structures will be organized by day-of-year, with subdirectories for specific field activities (GPS data, survey data, etc.). All field data will be backed up onto CD ROM or tape on a daily basis, and will also be transferred to an offsite CH2M HILL location.

All data (field data, GIS data, geophysical processing, and analysis data) will be backed up as a complete system on a weekly basis onto CD. Two copies of the CD will be created, with one copy stored in the office trailer and one copy sent to an offsite CH2M HILL location.

3.13 Interim Reporting

Access to interim data will be provided via a project internet web site or other appropriate method. All digital data will be provided in formats compatible with the LANTDIV's computer systems. Interim data will include:

- CADD base and topographic maps for all OE removal grids, with grid control points, in Intergraph .DGN or AutoCAD Release 14 .DXF format
- Draft and final geophysical data, as specified in Section 3.7, for all OE/MEC removal grids
- Grid data and QC reports for all OE/MEC removal grids in Word97 format
- Draft and final anomaly lists for all OE/MEC removal grids in Excel97 format
- Dig lists and relocation coordinates for all OE/MEC removal grids in Excel97 format
- Anomaly excavation reports for all OE/MEC removal grids in Excel97 format
- QA dig lists and excavation reports for all OE/MEC removal grids in Excel97 format

3.14 Final Reports and Maps

All sensor data will be pre-processed for sensor offsets and diurnal magnetic variations, and correlated with navigation data. The approved geophysical mapping technology will digitally capture the instrument readings into a file coincident with the state grid coordinates. This field data will be checked, corrected, and processed into ASCII files in the ADF file format. Corrections such as for navigation and instrument bias will be applied, but there will be no filtering or normalization of the data. All corrections will be documented.

The data will be presented in delineated fields as x, y, and z, where x and y are state plane coordinates in east and north, and z is the instrument reading. Where there are multiple instrument values, such as with the EM instruments, the channels will be provided in separate files. Each of the three data fields will be separated by a space (not a comma). TDEM data will consist of two separate files of three columns in the same format, with the z component for the top and bottom coils (for the EM-61) or for the early and late time gates (for the EM-61HH) in separate files. No header or other information will be included in the file. No individual file may be more than 4 megabytes in size and no more than 60,000 lines long. Each grid of data will be logically and sequentially named so that the file name can be correlated easily with the grid name used by other project personnel.

A digital planimetric map of each OE/MEC removal grid, in Intergraph .DGN format or AutoCAD Release 14 .DXF format, will be made available to LANTDIV for inspection prior to the collection of any new grid geophysical data. These maps will reflect the current site conditions after site preparation work (removal of fencing, dumpsters, play-sets, etc.) has been completed. These maps will be in state plane coordinates, and will coincide with the location of the geophysical survey data.

The complete digital geophysical data set for each OE/MEC removal grid will be made available for LANTDIV inspection within approximately 7 days of the completion of survey activities for that grid. All data is considered to be in draft form until LANTDIV comments are received and addressed.

The geophysical data for each OE/MEC removal grid will be accompanied by a Microsoft Word file documenting the field activities associated with the data collection, the data processing performed, and the results of the CH2M HILL QC review.

SECTION 4

CH2M HILL Site Safety and Health Plan

This Site Safety and Health Plan will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL Corporate Health and Safety Program, Program and Training Manual, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must sign Attachment 1. The main object of this project is to conduct a surface OE/MEC and scrap metal survey and anomaly reacquisition. CH2M HILL's SOP HSE-91 for OE/MEC is included in Appendix B as Attachment 2 of this plan.

4.1 Project Information and Description

PROJECT NO: 175685.FI.ZZ

CLIENT: United States Navy

PROJECT/SITE NAME: Preliminary OE/MEC Investigation and Anomaly Reacquisition for Red Beach and Blue Beach

SITE ADDRESS: Vieques Island, Puerto Rico

CH2M HILL PROJECT MANAGER: Marty Clasen/Fernando Ferreira

CH2M HILL OFFICE: Tampa, Florida

DATE HEALTH AND SAFETY PLAN PREPARED: October 11, 2002

DATE(S) OF SITE WORK: December 2002

SITE ACCESS: All investigation sites are located at the Eastern Maneuver Area, in the eastern portion of Vieques Island, Puerto Rico. All sites are accessed through the secure gate of Camp Garcia.

SITE SIZE: 14,000 acres

4.1.1 Site Topography

The regional topography of Vieques consists generally of hills and valleys throughout the entire island. The western side of the island consists of gently rolling hills with a deeper soil profile than the eastern, more exposed rugged terrain. The highest point on the western side of the island is found at Monte Pirata with an elevation of 1,000 ft, while the highest point on the eastern side is found at Cerro Matias with an elevation of 420 ft. The coastal areas contain level terrain made up primarily of lagoons and mangrove swamps.

4.1.2 Prevailing Weather

The climate of Vieques is characterized as warm and humid (tropical-marine), with frequent showers occurring throughout the year. The temperature on Vieques is affected by the easterly trade winds blowing across the island year-round. This wind moderates the temperature throughout the year, causing an annual mean temperature of 79ºF to 80ºF, and a mean daily temperature variation of 15ºF to 25ºF. The average annual rainfall on the island is approximately 36 inches, with extremes of 25 inches in the east and 45 to 50 inches in the west.

4.1.3 Site Description and History

Vieques is the largest offshore island of Puerto Rico, with a surface area of approximately 51 square miles. It is located approximately 7 miles east-southeast of the eastern end of the main island of Puerto Rico, where NSRR is located.

The AFWTF provides facilities and schedules NGFS and ATG ordnance delivery training for Atlantic Fleet ships, NATO ships, air wings, and smaller air units from other allied nations and the Puerto Rican National Guard. The Fleet Marine Force, Atlantic, conducts training for Marine amphibious units, battalion landing teams and combat engineering units in the EMA. Occasionally, naval units of allied nations having a presence in the Caribbean and the Puerto Rican National Guard also utilize the EMA.

The training areas have been used continuously since World War II when the Navy acquired title to the land. Within the Inner Range, the Atlantic Fleet's ships, aircraft and marine forces carry out training in all aspects of NGFS, ATG ordnance delivery, air-to-surface mine delivery, amphibious landings, small arms, artillery and tank fire, and combat engineering. As part of normal operations, unexploded ordnance is periodically cleared from the AFWTF's "Inner Range" and destroyed by OD at the Facility.

AFWTF operations have precluded outside development from occurring on the property and have resulted in the area remaining undeveloped. Before April 1999, public access to Red Beach and Blue Beach was allowed. Proposed future uses for the site include public beach access.

4.2 Tasks to be Performed Under this Plan

4.2.1 Description of Tasks

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Section 4.3) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin.

FIGURE 4-1 SITE MAP

Note locations of Support, Decontamination, and Exclusion Zones; site telephone; first aid station; evacuation routes; and assembly areas.

TO BE INCLUDED DURING IMPLEMENTATION OF THE FIELD PROGRAM

4.2.1.1 Hazwoper-Regulated Tasks

- Site Layout
- Surface geophysical surveys
  - Magnetic
  - Electromagnetic
- Anomaly reacquisition
- Anomaly Recovery

4.2.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites**.

Tasks	Controls
• None	• Not applicable

4.3 Activity Hazard Analysis for MEC

Principal Steps	Potential Hazards	Recommended Controls
Transportation of explosive materials [1]	Accidental detonation of explosives	Explosives will be transported in accordance with the 49, Code of Federal Regulations (CFR), Parts 100-199.
		Explosives will be transported in closed vehicles whenever possible.
		When using an open vehicle, explosives will be covered with a flame resistant tarpaulin.
		Motor vehicles will be shut off when loading/unloading explosives.
		Beds of vehicles will have either a nonconductive bed liner, dunnage, or sand bags to protect the explosives from contact with the metal bed and fittings.
		Initiating explosives, such as blasting caps, will remain separated at all times.
		Each vehicle used for the transport of OE/MEC will be outfitted with a fire extinguisher and first aid kit.
		Do not fuel trucks when loaded with OE/MEC.
	Unqualified Drivers	Drivers operating outside the boundaries of any federal installation will be licensed in accordance with federal, state, and local regulations.

Principal Steps	Potential Hazards	Recommended Controls
Transportation of explosive materials (continued)	Vehicle operations	Drivers will observe all posted speed limits while operating a motor vehicle on a public roadway.
		Vehicles transporting explosives offroad will not exceed 15 miles per hour (mph).
		Chock wheels when loading or unloading OE/MEC-related materials.
Storage of explosive materials [1]	Accidental detonation of explosives	Materials will be stored in accordance with federal, state and local regulations.
		Refer to the SOP for the Storage of Explosive Materials.
Surveying and establishing boundaries and grids.	Accidental detonation of explosives	Personnel involved will attend a site-specific OE/MEC recognition class prior to the commencement of any site activities.
		UXO personnel will escort non-UXO personnel at all times.
		Mark and avoid OE/MEC. Only UXO personnel will handle OE waste.
		Check location with magnetometer prior to driving stakes.
	Wildlife, slips, trips, falls, insects, poisonous plants, use of hand tools.	Refer to the Activity Hazard Analysis for section of this SSHP.
Clearing and grubbing	Accidental detonation of explosives	Personnel involved will attend a site-specific OE/MEC recognition class prior to the commencement of any site activities.
		Be alert and mark all OE/MEC located.
		Only clear and grub to within 4 inches of the ground surface.
		UXO trained personnel will escort non-UXO personnel at all times.
		Surface sweeps will be conducted with magnetometers or other suitable geophysical instrumentation to identify potential OE/MEC.
Transportation of OE Waste [1]	Accidental detonation of explosives	No personnel allowed in OE/MEC cargo department of vehicle.
	Accidental detonation of explosives	No OE/MEC allowed in passenger compartment of vehicle.
		Block, brace, secure OE/MEC.
		No smoking in vehicles used for transport of OE/MEC waste.
	Vehicle operations	Placard vehicle in accordance with U.S. Department of Transportation (DOT) regulations.
		Vehicles transporting explosives offroad will not exceed 25 mph.
		Drivers will observe all posted speed limits while operating a motor vehicle on a public roadway.

Principal Steps	Potential Hazards	Recommended Controls
OE/MEC disposal operations [1]	Accidental detonation of explosives	Observe procedures outlined in EODB 60A-1-1-31.
OE/MEC-Related Scrap Demilitarization	Accidental detonation of explosives	Only UXO technicians will perform explosive demilitarization of OE/MEC-related scrap.
	Shredder Operations	Stay clear of moving mechanical parts.
		Ensure that only inspected scrap is fed into shredder.
Inspection/Certification of OE/MEC Related Scrap	Accidental detonation of explosives	Only OE/MEC technicians will inspect OE-related scrap.
		Personnel in the immediate vicinity of OE/MEC-related scrap inspections will be kept to the minimum necessary for safe operations but no less than two UXO technicians.
		Observe requirements of DoD 4160.21-M-1.
Anomaly Reacquisition	Accidental detonation	Only UXO technicians will excavate or handle OE/MEC.
		Personnel in the immediate vicinity of OE/MEC operations will be kept to the minimum necessary for safe operations, but no less than two UXO technicians.
		Do not subject OE/MEC to heat, shock, or friction.
		Only hand excavation permitted when within 1 ft of OE/MEC.
		Magnetometers will be used frequently to pinpoint the location of OE/MEC.
	Non-UXO personnel	Establish EZ; post warning signs, maintain site control.
		Stop all OE/MEC operations when non-OE/MEC trained personnel are within the EZ.
Clearing and Grubbing of Vegetation	Cutting tools, chain saws, weed cutters	Eye, hand, foot, and hearing protection (Level D). Face shield and chaps will be worn by chain saw operators. Personnel using chain saws, cutting tools, and weed cutters must provide safe distance between workers and be cautious of tools.

Equipment to be Used	Inspection Requirements	Training Requirements
Vehicles Fire extinguishers First aid kits Demolition materials Explosives Blocking, bracing, and cushioning materials Manual hand tools Mechanized equipment Earth moving machinery Geophysical instrumentation Global Positioning System instrumentation PPE Communications equipment	Daily preventive maintenance and operational checks First aid kits Calibration of geophysical instrumentation	40-hour qualification per 29 CFR 1910.120 8-hour refresher OE/MEC personnel EOD trained Tailgate safety meetings Site-specific orientation Lead awareness training

[1] For the Blue and Red Beach Preliminary OE/MEC investigation, only NSRR EOD personnel will transport OE/MEC material and explosives.

4.4 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SSC for clarification.

4.4.1 Project-Specific Physical (Safety) Hazards

The main physical or safety hazards posed to CH2M HILL personnel during project activities are:

- Thermal (heat) stress
- Noise
- Explosion and fire
- Utilities
- Heavy equipment
- Fall hazards
- Ordnance

The health and safety control measures for these hazards are outlined in the following section of this plan.

4.4.2 General Hazards and Housekeeping

- Site work will be performed during daylight hours whenever possible. Work conducted during hours of darkness will require enough illumination intensity to read a newspaper without difficulty.
- Hearing protection must be worn in areas where you need to shout to hear someone within 3 ft.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Stairs or ladders are generally required when there is a break in elevation of 19 inches or more.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.

- As work progresses, scrap and unessential materials must be stored neatly or removed from the work area.
- Containers should be provided for collecting trash and other debris, and these containers shall be removed at regular intervals.
- All spills shall be cleaned up quickly. Oil and grease shall be cleaned from walking and working surfaces.

4.4.3 Hazard Communication

The SSC is to perform the following:

- Complete an inventory of chemicals brought onsite by CH2M HILL using Attachment 3.
- Confirm that an inventory of chemicals brought onsite by CH2M HILL subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive onsite, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.

4.4.4 Shipping and Transportation of Chemical Products

Chemicals are not expected to be needed as part of the field efforts. If chemicals are determined to be necessary, these chemicals might be defined as hazardous materials by the DOT. All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

4.4.5 Manual Lifting

- Proper lifting techniques must be used when lifting any object.
  - Plan storage and staging to minimize lifting or carrying distances.
  - Split heavy loads into smaller loads.
  - Use mechanical lifting aids whenever possible.
  - Have someone assist with the lift, especially for heavy or awkward loads.
  - Make sure the path of travel is clear prior to the lift.

4.4.6 Slips, Trips and Falls

- Institute and maintain good housekeeping practices.
- Pick up tools and debris in the work area.

- Walk or climb only on equipment surfaces designed for personnel access.
- Be aware of poor footing and potential slipping and tripping hazards in the work area.

4.4.7 Fire Prevention

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 ft. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 ft. Extinguishers must:
  - Be maintained in a fully charged and operable condition
  - Be visually inspected each month
  - Undergo a maintenance check each year
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 ft from any building.
- Solvent waste and oily rags must be kept in a fire-resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

4.4.8 Electrical

- All temporary wiring, including extension cords, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
  - Equipped with third-wire grounding
  - Covered, elevated, or protected from damage when passing through work areas
  - Protected from pinching if routed through doorways
- Electrical power tools and equipment must be effectively grounded or double-insulated UL-approved.
- Electrical power tools, equipment, and cords are to be inspected for damage before use. If damaged, they should be tagged and removed from service.
- Operate and maintain electrically powered equipment according to manufacturer's instructions.
- Protect all electrical equipment, tools, switches, and outlets from elements.
- Only qualified personnel are to work on energized electrical circuits and equipment. Only authorized personnel are permitted to enter high-voltage areas.

- Properly label switches, fuses, and breakers.
- All 120-volt, single phase 15 and 20 ampere receptacle outlets on construction sites which are not part of the permanent building wiring must be equipped with GFCIs for personnel protection.
- All portable electric generator receptacles must be effectively grounded by bonding the receptacle grounding wire to the generator frame.

4.4.9 Ladders

- Ladders must be inspected by a competent person for visible defects prior to each day's use. Defective ladders must be tagged and removed from service.
- Portable ladders must extend at least 3 ft above landing surface.
- User must face the ladder when climbing; keep belt buckle between side rails.
- User must use both hands to climb; use rope to raise and lower equipment and materials.
- Straight and extension ladders must be tied off to prevent displacement.
- Ladders that may be displaced by work activities or traffic must be secured or barricaded.
- Fixed ladders greater than 20 ft in height must be provided with fall protection devices.
- Stepladders are to be used in the fully opened and locked position.
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top of or straddle a stepladder.
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder.

4.4.10 Heat and Cold Stress

4.4.10.1 Preventing and Treating Heat Stress

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50ºF to 60ºF should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Take regular breaks in a cool, shaded area. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation The devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.

- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Provide adequate shelter or shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Monitor buddy for signs of heat stress. Persons who experience signs of heat rash or heat cramps should consult the SSC to avoid progression of heat-related illness.
- Those who experience heat syncope (sudden fainting), heat exhaustion (hot, pale, clammy / moist skin), or heat stroke (red, hot, dry skin; loss of consciousness) must be cooled down immediately and provided cool water or sports drink. Persons who experience heat syncope or heat exhaustion should also seek medical attention as soon as possible. Persons who experience heat stroke must get immediate medical attention.

4.4.10.2 Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (greater than 50 percent), or when workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats / minute, or 20 beats / minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats / minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats / minute, or 20 beats / minute above resting pulse.

4.4.10.3 Preventing and Treating Cold Stress

- Be aware of the symptoms of cold-related disorders, and wear proper clothing for the anticipated fieldwork.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC) (CH2M HILL SOP HS-09).
- Wind-Chill Index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it is used only as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.

- Persons who experience signs of incipient frost bite (frost nip) or incipient hypothermia (generally cold, shivering) should consult the SSC to avoid progression of cold-related illness.
- Persons who experience signs of frost bite (discolored, waxy, resilient skin) or hypothermia (low body temperature characterized by uncontrollable shivering, weakness, apathy, etc.) must be warmed and provided warm fluids (not hot, and no caffeinated drinks), and must get immediate medical attention.

4.4.11 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or being exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

4.4.12 Procedures for Locating Buried Utilities

Local Utility Mark-Out Service

Name: Caleb Romero, NSSR, Puerto Rico
Phone: (787) 865-4429, Ext. 4068 / 4268

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).
- When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SSC should confirm that arrangement.

4.4.13 Working Near Water

When working near water, and there is a risk of drowning:

- U.S. Coast Guard-approved personal flotation devices (PFDs), or life jacket, provided for each employee will be worn.
- PFDs will be inspected before and after each use. Defective equipment will not be used.
- Sampling and other equipment will be used according to the manufacturer's instructions.
- A minimum of one life-saving skiff will be provided for emergency rescue.
- A minimum of one ring buoy with 90 ft of 3/8-inch solid-braid polypropylene (or equal) rope will be provided for emergency rescue.

4.4.14 Working on Water

- Safe means of boarding or leaving a boat or a platform will be provided to prevent slipping and falling.
- The boat/barge must be equipped with adequate railing.
- Employees should be instructed on safe use.
- Work requiring the use of a boat will not take place at night or during inclement weather.
- The boat/barge must be operated according to U.S. Coast Guard regulations (speed, lightning, right-of-way, etc.).
- The engine should be shut off before refueling; do not smoke while refueling.

4.4.15 IDW Drum Sampling

Personnel are permitted to handle or sample drums containing investigation-derived waste (IDW) only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW:

- Minimize transportation of drums.
- Sample only labeled drums or drums known to contain IDW.
- Use caution when sampling bulging or swollen drums. Relieve pressure slowly.
- If drums contain (or may potentially contain) flammable materials, use non-sparking tools to open.
- Picks, chisels, and firearms may not be used to open drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer the content of drums using a method that minimizes contact with material.

- Personal protective equipment (PPE) and air monitoring requirements specified in Sections 4.6 and 4.7 must address IDW drum sampling.
- Spill-containment procedures specified in Section 4.9 must be appropriate for the material to be handled.

4.4.16 Confined Space Entry

No confined space entry will be permitted. Confined space entry requires additional health and safety procedures, training, and a permit. If conditions change such that confined-space entry is necessary, contact the HSM to develop the required entry permit.

When planned activities will not include confined-space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before the task begins. The SSC is to confirm that permit spaces are properly posted or that employees are informed of their locations and hazards.

4.4.17 Working Around Material Handling Equipment

- Never approach operating equipment from the rear. Always make positive contact with the operator, and confirm that the operator has stopped the motion of the equipment.
- Never approach the side of operating equipment; remain outside of the swing and turning radius.
- Maintain distance from pinch points of operating equipment.
- Because heavy equipment may not be equipped with properly functioning reverse signal alarms, never turn your back on any operating equipment.
- Never climb onto operating equipment or operate contractor/subcontractor equipment.
- Never ride contractor/subcontractor equipment unless it is designed to accommodate passengers, and is equipped with a firmly attached passenger seat.
- Never work or walk under a suspended load.
- Never use equipment as a personnel lift; do not ride excavator buckets or crane hooks.
- Always stay alert and maintain a safe distance from operating equipment, especially equipment on cross slopes and unstable terrain.

4.4.18 Biological Hazards and Controls

4.4.18.1 Snakes

No poisonous snakes are indigenous to Puerto Rico.

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical

attention immediately. DO NOT apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

4.4.18.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

4.4.18.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in length. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray only outside of clothing with permethrin or permanone and spray skin only with DEET. Check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). With Lyme disease, a rash might appear that looks like a bullseye with a small welt in the center. With RMSF, a rash of red spots might appear under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

4.4.18.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

4.4.18.5 Bloodborne Pathogens

Exposure to bloodborne pathogens may occur when rendering first aid or cardio-pulmonary resuscitation (CPR), or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and PPE are required as specified in CH2M HILL SOP HS-36, Bloodborne Pathogens. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

4.4.18.6 Other Anticipated Biological Hazards

The following paragraphs identify the potential hazards associated with flora and fauna at the site. If additional concerns are identified, they will be added to this SSHP.

4.4.18.6.1 Hazardous Flora

Incidence of contact by individuals to poisonous and thorny plants is high, especially during surface water and sediment sampling activities; therefore, bare skin should be covered (i.e., long pants and shirt, steel-toed boots, leather or cotton gloves, safety glasses, and head protection) as much as practical when working in forested or densely vegetated areas. Personnel should avoid entering an area in the direct path of known poisonous flora; a secondary route should be selected. Care should also be taken when walking in such areas because uneven terrain or vines may present a tripping hazard.

While attempting to cut into dense underbrush, hazards exist from the sharp machete and gas-powered weed cutter. Therefore, care should be taken when using such devices. (Note: Hearing protection, steel-toed boots, gloves, and safety glasses are required when using weed cutters.) All rashes and other injuries will be reported to the Site Health and Safety Officer (SHSO) as soon as they are known.

4.4.18.6.2 Hazardous Fauna

Mosquitoes and sand flies pose a nuisance and physical hazard to field personnel; they distract workers, leading to accidents, and pose a physical threat by transmitting live microorganisms. Sand fly bites that are repeatedly scratched can cause secondary infections. Avoid the use of perfumes and scented deodorants, and don light colored clothing. The use of Avon's "Skin So Soft" or other insect repellent is encouraged.

The potential exists to come in contact with other dangerous insects; these include centipedes, fire ants, bees, wasps, hornets, mites, fleas, and spiders. All personnel should perform "checks" on each other periodically and at the end of the work shift, especially when working in grassy or forested areas. All insect bites must be reported to the SHSO.

No poisonous snakes are indigenous to Puerto Rico, only non-poisonous snakes such as the Boa Constrictor. Feral (wild) dogs and cats have been observed.

Mongooses, rats, and mice have been documented to (potentially) carry rabies. Some evidence exists that mongooses can be infected with the rabies virus in an attenuated form, allowing them to carry and spread the virus for considerable time before succumbing to the disease. Any observed unusual behavior by mongooses and other mammals must be reported. Signs of rabies can be characterized in two forms. Furious rabies exhibits agitation and viciousness, followed by paralysis and death. Dumb rabies exhibits lethargy and paralytic symptoms, followed by death. Behavioral indicators for both include fearlessness and change in nocturnal / diurnal rhythms.

Working in wet or swampy areas unprotected shall not be allowed because of the presence of a variety of etiologic (disease-causing agents). Contact with surface water will be kept to a minimum. Several incidents of infection by schistosomes (blood flukes) from contact with surface water have been reported. The aquatic snail vector, *Australorbis glabratus*, transmits the schistosomes into surface waters, predominantly drainage ditches. Even momentary contact (especially in the presence of blisters, cuts, and open sores) with contaminated surface water is sufficient to acquire an infection. Accidental skin contact requires that the area be washed with isopropyl alcohol (as directed by SHSO). Symptoms of infection are fever, diarrhea, itchy skin, and central nervous system (CNS) damage. Schistosomiasis is difficult to treat; once established in its host, it may remain for several years.

Before beginning site activities, each individual shall be questioned as to any known sensitivities to the previously mentioned organisms or agents.

4.4.18.7 Dengue Fever and Other Illnesses

According to the Centers for Disease Control (CDC), Dengue Fever is primarily a viral infection transmitted by mosquito bites in residential areas. The mosquitoes are most active during the day, especially around dawn and dusk, and are frequently found in and around human habitations. The illness is flu-like and characterized by sudden onset, high fever, severe headaches, joint and muscle pain, and rash. The rash appears 3 to 4 days after the onset of fever. Because no vaccine or specific treatment exists, prevention is important. To reduce mosquito bites, travelers should wear clothes that cover most of the body. Travelers should also take insect repellent with them to use on any exposed areas of skin. The most effective repellent is DEET (N,N-diethyl meta-toluamide). Avoid applying high-concentration DEET (greater than 35 percent) products to the skin and refrain from applying repellent to portions of the hands that are likely to come in contact with the eyes and mouth. Rarely, toxic reactions or other problems have developed after contact with DEET. Please note that personnel performing water sampling should refrain from using DEET because the breakdown products can show up as false positive results in laboratory analysis. For greater protection, clothing can be soaked in or sprayed with permethrin, which is an insect repellent licensed for use on clothing. If applied according to directions, permethrin will repel insects from clothing for several weeks.

Traveler's Diarrhea is the most frequent health problem for travelers. It can be caused by viruses, bacteria, or parasites that are found universally throughout the region. Transmission is most often through contaminated food or water. Purchase food and beverages from vendors that are professional. Avoid small roadside stands and drink bottled beverages when possible. The use of over-the-counter or prescriptions medications can reduce the length of the attack.

Hepatitis A is a viral infection of the liver transmitted by the fecal oral route; through direct person to person contact; from contaminated water, ice, or shellfish; or from fruits or uncooked vegetables contaminated through handling. Symptoms include fatigue, fever, loss of appetite, nausea, dark urine, jaundice, vomiting, aches and pains, and light stools. No specific therapy is available, only supportive care. The virus is inactivated by boiling or cooking to 85ºC (185ºF) for 1 minute. Therefore, eating thoroughly cooked foods and drinking only treated water serve as general precautions. CDC recommends hepatitis A vaccine as a precaution.

4.4.18.8 Fire ant bites

Fire ants typically build mounds on the land surface that are usually easy to identify. Avoid disturbing these mounds. A bite from a fire ant can be painful but rarely is life threatening. It is possible, however, that the bite could cause an allergic reaction. If bitten, check for symptoms of an allergic reaction such as weakness, nausea, vomiting, dizziness, or shortness of breath. If symptoms appear, seek medical attention.

4.4.19 Radiological Hazards and Controls

Radiological hazards are not expected at this site. If new or additional information is provided that indicates that radiological hazards may be present, stop work and refer to CH2M HILL's Corporate Health and Safety Program, Program and Training Manual, and Corporate Health and Safety Program Radiation Protection Manual for standards of practice in contaminated areas.

4.4.20 Contaminants of Concern

Based on previous investigations, contaminants other than potential OE/MEC are not anticipated at Blue and Red Beaches.

4.4.21 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	**Inhalation**: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4.6 and 4.7, respectively.	**Other**: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

4.5 Project Organization and Personnel

4.5.1 CH2M HILL Employee Medical Surveillance and Training

The employees listed in this subsection are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Lead awareness training is provided in Attachment 6 of this plan. The quiz must be completed successfully by project personnel exposed to lead during OE/UXO operations.

OE/MEC subcontractors are responsible for providing a competent person to oversee OE/MEC operations. A competent person may be a SUXOS, UXOSO, UXO QC Specialist, or a UXO Technician III. The competent person must meet the following minimum qualification requirements:

- Be a graduate of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval EOD School, Indian Head, MD; U.S. Naval EOD

School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal AL; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DoD-certified equivalent course

- Have at least 10 years of combined active duty military EOD and contractor UXO experience
- Have experience in OE/MEC clearance operations and supervising personnel

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, Reproduction Protection, including obtaining a physician's statement of the employee's ability to perform hazardous activities, before being assigned field work.

Employee Name	Office	Responsibility	SSC/FA-CPR
Fernando Ferreira	TPA	Project Manager	Level D SSC; FA-CPR
Gary Webb	SEA	UXO Safety Officer	Level D SSC; FA-CPR*
Kevin Sanders	GNA	Field Team Member	Level D FA-CPR

4.5.2 Field Team Chain of Command and Communication Procedures

Client

Contact Name: Madeline Rivera, IRP Manager, NSRR
Phone: (787) 865-5337
Facility Contact Name: N/A
Phone: N/A

CH2M HILL

Project Manager: Fernando Ferreira/TPA
Health and Safety Manager: Mike Goldman/ATL
UXO Safety Officer/SSC: Gary Webb/SEA

CH2M HILL Subcontractors

Subcontractor: USA Environmental (for OE/MEC avoidance and clearance)
Subcontractor Contact Name: Brian Thompson
Telephone: (813) 884-5722

Subcontractor: NAEVA (for Surface Geophysics survey)
Subcontractor Contact Name: John Bresnick
Telephone: (434) 978-3187

These subcontractors are covered by this SSHP and must be provided a copy of this plan. This plan does not, however, address hazards associated with the tasks and equipment in which the subcontractor has expertise (e.g., UXO clearance). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and should include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both CH2M HILL's and the subcontractor's SSHPs.

Health and safety-related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Sheet included in Attachment 1.
- Ask subcontractor(s) to brief the project team on the hazards and precautions related to their work.
- When apparent non-compliance / unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action; the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeated non-compliance / unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in the project field logbook, daily reports, or other records.

Contractors

This plan does not address contractors who are contracted directly to the client or the owner. CH2M HILL is not responsible for the health and safety or means and methods of the contractor's work, and must never assume such responsibility through our actions (e.g., advising on safety and health issues). In addition to this plan, CH2M HILL staff should review contractor safety plans so that we remain aware of appropriate precautions that apply to us. Except in unusual situations when conducted by the HSM, CH2M HILL must never comment on or approve contractor safety procedures. Self-assessment checklists contained in Attachment 5 are to be used by the SSC to review the contractor's performance ***only*** as it pertains to evaluating our exposure and safety.

Safety and health-related communications with contractors should be conducted as follows:

- Ask the contractor to brief CH2M HILL employees and subcontractors on the precautions related to the contractor's work.
- When an apparent contractor non-compliance / unsafe condition or practice poses a risk to CH2M HILL employees or subcontractors:

  - Notify the contractor safety representative
  - Request that the contractor determine and implement corrective actions
  - If needed, stop affected CH2M HILL work until contractor corrects the condition or practice. Notify the client, Project Manager, and HSM as appropriate.

- If apparent contractor non-compliance / unsafe conditions or practices are observed, inform the contractor safety representative. Our obligation is limited strictly to informing the contractor of our observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions.

- If an apparent imminent danger is observed, immediately warn the contractor employee(s) in danger and notify the contractor safety representative. Our obligation is limited strictly to immediately warning the affected individual(s) and informing the contractor of our observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions.

- Document all oral health and safety related communications in the project field logbook, daily reports, or other records.

4.6 Personal Protective Equipment (PPE)

PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
General site entry Surveying				
OE/MEC surveys and removals Observation of material loading for offsite disposal Oversight of remediation and construction	D	Work clothes; steel-toed, leather work boots [g]; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
Tasks requiring OE/MEC anomaly reacquisition in contamination area	Modified D	Work clothes or cotton coveralls Boots: Steel-toed, chemical-resistant boots [g] OR steel-toed, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses Ear protection [d]	None required
Tasks requiring upgrade or downgrade for reasons presented below	C	Coveralls: Polycoated Tyvek® Boots: Steel-toed, chemical-resistant boots [g] OR steel-toed, leather work boots [g] with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat c Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent.

Reasons for Upgrading or Downgrading Level of Protection

Upgrade[f]	Downgrade
• Request from individual performing tasks • Change in work tasks that will increase contact or potential contact with hazardous materials • Occurrence or likely occurrence of gas or vapor emission • Known or suspected presence of dermal hazards • Instrument action levels (Section 4.7) exceeded	• New information indicating that situation is less hazardous than originally thought • Change in site conditions that decreases the hazard • Change in work task that will reduce contact with hazardous materials

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to be determined by the SSC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 ft or less without shouting.

[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is >85 percent, or if organic vapor measurements are > midpoint of Level C range (refer to Section 4.7)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.

[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

[g] Steel-toed boots are not required during surface geophysics mapping.

4.7 Air Monitoring/Sampling

4.7.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]		Frequency[b]	Calibration
PID: OVM with 10.6eV lamp or equivalent	OE/MEC anomaly reacquisition in contaminated areas	0 – 1 ppm >1 – 5 ppm > 5 ppm	Level D Level C Stop Work	Initially and periodically during task	Daily
Detector Tube: Drager benzene specific 0.5/c (0.5 to 10 ppm range) with pre-tube, or equivalent	When positive PID indications >1 ppm	<0.5 ppm 0.5-1 ppm >1 ppm	Level D Level C Level B	Initially and periodically when PID/FIB >1 ppm	Not applicable

[a] Action levels apply to sustained breathing-zone measurements (2 minute duration) above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., “Breathing Zone/MW-3”, “at surface/SB-2”, etc.).

4.7.2 Calibration Specifications

PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing

4.7.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other Occupational Safety and Health Act (OSHA) regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain VOCs. Contact the HSM immediately if these contaminants are encountered.

4.7.3.1 Method Description

No air monitoring is expected to be necessary for this project. Therefore, no method description is provided.

4.7.3.2 Personnel and Areas

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: No air monitoring is expected to be necessary for this project. Therefore, no reporting of air monitoring results will be necessary.
Other: No air monitoring is expected to be necessary for this project. Therefore, no reporting of air monitoring results will be necessary.

4.8 Decontamination

The SSC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SSC. The SSC must ensure that procedures are established for disposing of materials generated on the site.

4.8.1 Decontamination Specifications

Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse • Glove wash/rinse • Outer-glove removal • Body-suit removal • Inner-glove removal • Respirator removal • Hand wash/rinse • Face wash/rinse • Shower ASAP • Dispose of PPE in municipal trash, or contain for disposal • Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal	• Wash/rinse equipment • Solvent-rinse equipment • Contain solvent waste for offsite disposal	• Power wash • Steam clean • Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

4.8.2 Diagram of Personnel Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas, EZs, or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 4-2 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

4.9 Spill Prevention and Containment Procedures

This Spill Prevention and Containment section establishes minimum site requirements. Subcontractors are responsible for spill prevention and control related to their operations. Subcontractors' written spill prevention and control procedures must be consistent with this plan. All spills must be reported to a supervisor, the site superintendent, and the Project Manager.

4.9.1 Spill Prevention

All fuel and chemical storage areas will be properly protected from onsite and offsite vehicle traffic. Fuel storage tanks must be equipped with secondary containment. Fuel tanks must be inspected daily for signs of leaks. Accumulated water must be inspected for signs of product before discharge.

Chemical products must be stored and transferred properly and used in a safe manner. If chemical product use occurs outside areas equipped with spill control materials, adequate spill control materials must be maintained.

4.9.2 Spill Containment and Control

Spill control materials will be maintained in the support zone and at fuel storage and dispensing locations. Incidental spills will be contained with sorbent and disposed of properly. Spilled materials must be immediately contained and controlled. Spill response procedures include taking the following actions:

- Immediately warn any nearby personnel and notify the work supervisor
- Assess the spill area to ensure that it is safe to approach
- Activate site evacuation signal if the spill presents an emergency
- Ensure that any nearby ignition sources are immediately eliminated
- If it can be done safely, stop the source of the spill
- Establish site control for the spill area
- Use proper PPE in responding to the spill
- Contain and control spilled material through the use of sorbent booms, pads, or other materials

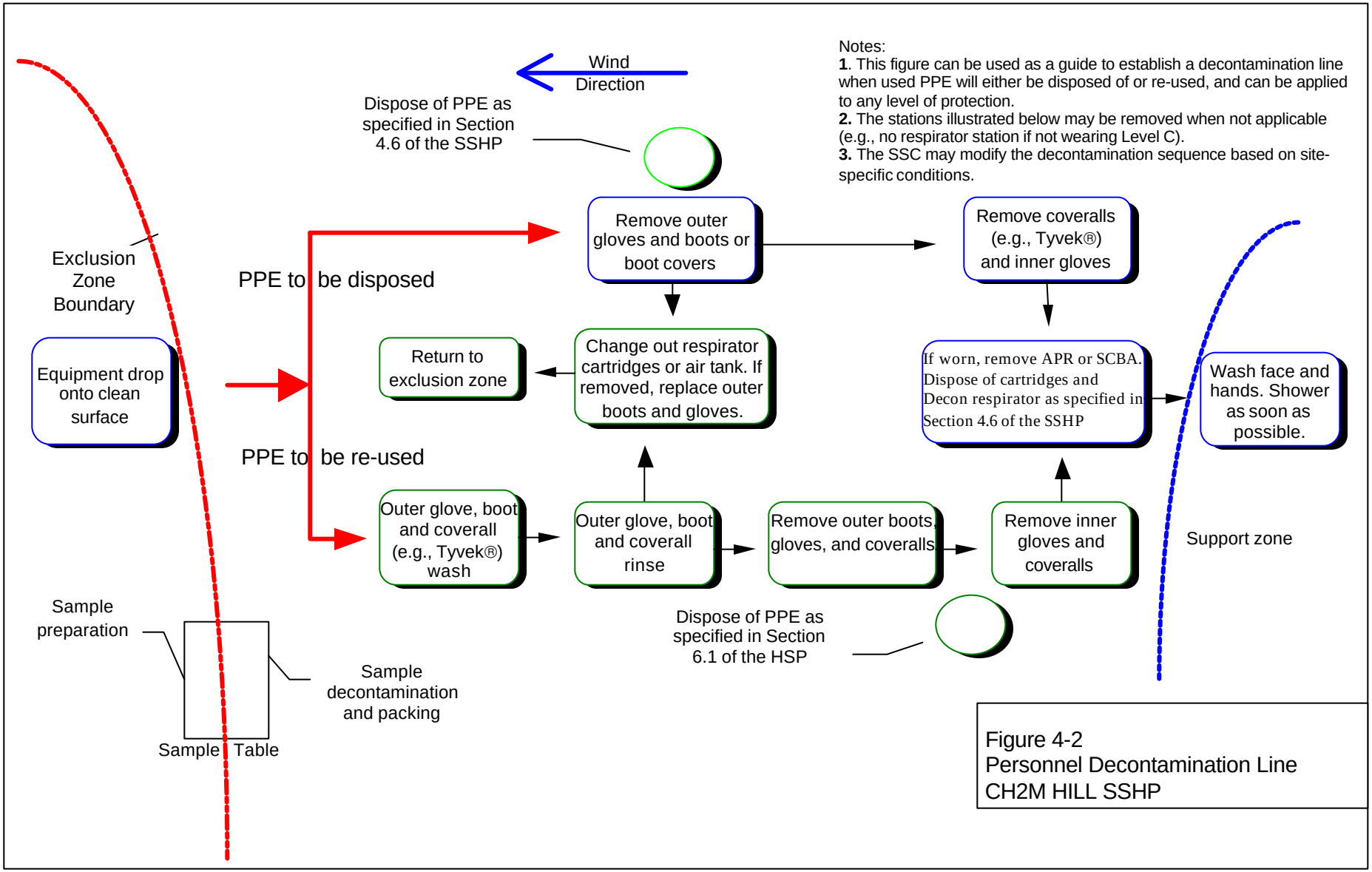

Figure 4-2
Personnel Decontamination Line
CH2M HILL SSHP

4.9.3 Spill Clean-up and Removal

All spilled material, contaminated sorbent, and contaminated media will be cleaned up and removed as soon as possible. Contaminated spill material will be drummed, labeled, and properly stored until material is disposed of. Contaminated material will be disposed of according to applicable federal, state, and local requirements. Contact the regulatory compliance person for the project or the program for assistance.

4.10 Site Control Plan

4.10.1 Site Control Procedures

- The SSC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing onsite safety include general discussion of the SSHP, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, and emergencies.
- The SSC records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL SOP HS-71, OSHA Postings.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the “buddy system.”
- Initial air monitoring is conducted by the SSC in appropriate level of protection.
- The SSC is to conduct periodic inspections of work practices to determine the effectiveness of this plan: refer to Sections 4.2 and 4.3. Deficiencies are to be noted, reported to the HSM, and corrected.

4.10.2 Hazwoper Compliance Plan

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 4.2.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This

section outlines procedures to be followed when approved activities specified in Section 4.2.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed onsite, or while non-Hazwoper-trained staff are working near Hazwoper activities. Other data (e.g., soil) also must document that no potential exists for exposure. The HSM must approve the interpretation of these data. Refer to subsections 4.4.20 and 4.7 for contaminant data and air sampling requirements, respectively.
- When non-Hazwoper-trained personnel are at risk of exposure, the SSC must post the exclusion zone and inform non-Hazwoper-trained personnel of the following:
  - Nature of the existing contamination and its locations
  - Limitations of their access
  - Emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that a potential for exposure to health and safety hazards no longer exists.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is (for the purposes of applying the Hazwoper standard) considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

4.11 Emergency Response Plan

4.11.1 Pre-Emergency Planning

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).

- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital.
- Brief new workers on the emergency response plan.

The SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

4.11.2 Emergency Equipment and Supplies

The SSC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20-lb (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Vehicle
Eye Wash	Support & Decon Zone/Field Vehicle
Potable water	Support & Decon Zone/Field Vehicle
Bloodborne pathogen kit	Support Zone/Field Vehicle
Additional equipment (specify):	N/A

4.11.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

4.11.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Section 4.11.8 (e.g., 911).
- The SCC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 4.11.7.

4.11.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SSC before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SSC and a “buddy” will remain onsite after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The SSC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternative assembly area(s).
- The SSC will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

4.11.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

4.11.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For CH2M HILL work-related injuries or illnesses, contact and help Human Resources administrator complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For CH2M HILL subcontractor incidents, complete the Subcontractor Accident / Illness Report Form and submit to the HSM.
- Notify and submit reports to client as required in contract.

4.11.8 Emergency Contacts (complete during project start-up)

24-hour CH2M HILL Emergency Beeper – 888/444-1226	
Medical Emergency – 911 Facility Medical Response #: Local Ambulance #: (787) 741-2151	CH2M HILL Medical Consultant Dr. Peter Greaney GMG WorkCare, Orange, CA (800) 455-6155 (After hours calls will be returned within 20 minutes)
Fire / Spill Emergency – 911 Facility Fire Response #: Local Fire Dept #: (787) 741-2111	Local Occupational Physician
Security & Police – 911 Facility Security #: (787) 741-0615 Local Police #: (787) 741-2020	Corporate Director Health and Safety Name: Mollie Netherland / SEA Phone: (206) 453-5005 24-hour emergency beeper: 888-444-1226
Utilities Emergency Water: Gas: Electric:	Health and Safety Manager (HSM) Name: Mike Goldman Phone: (770) 604-9182 (office) ext 592; (770) 335-2076 (Cell). Pager: (888) 856-9114
Site Safety Coordinator (SSC) Name: Gary Webb Phone: (360) 434-3420	Regional Human Resources Department Name: Mary Jo Jordan Phone: (352) 335-5877
Project Manager Name: Fernando Ferreira Phone: (321) 693-0169	Corporate Human Resources Department Name: John Monark / COR Phone: (303) 771-0900
Federal Express Dangerous Goods Shipping Phone: (800) 238-5355 CH2M HILL Emergency Number for Shipping Dangerous Goods Phone: (800) 255-3924	Worker's Compensation and Auto Claims Sterling Administration Services Phone: (800) 420-8926 After hours: (800) 497-4566 Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.
Federal Agency / Contact Name:	Phone:
State Agency / Contact Name:	Phone:
Local Agency / Contact Name:	Phone:
Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.	
Facility Alarms:	Evacuation Assembly Area(s):
Facility / Site Evacuation Route(s):	
Hospital Name / Address: NSRR	Hospital Phone #: (787) 741-2151
Directions to Hospital	
For minor first aid, proceed to public works Camp Garcia infirmary. For extreme or life threatening emergencies, call for helicopter from NSRR. (787) 865-5997	

4.12 Approval

This SSHP has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified, and must be amended if those conditions change.

4.12.1 Original Plan

Written By: Martin J. Clasen, P.G. Date: 10/10/02

Approved By: Date:

4.12.2 Revisions

Revisions Made By:_____ Date:

Revisions to Plan: _____

Revisions Approved By:_____ Date:

4.13 Attachments

Attachment 1: Employee Signoff Form – Site Safety and Health Plan

Attachment 2: CH2M HILL HSE-91, Ordnance Explosives (OE) SOP

Attachment 3: Project-Specific Chemical Product Hazard Communication Form

Attachment 4: Chemical-Specific Training Form

Attachment 5: Applicable Material Safety Data Sheets

Attachment 6: Lead Awareness Training

ATTACHMENT 1

CH2MHILL

EMPLOYEE SIGNOFF FORM

Site Safety and Health Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this FSI, have read and understood it, and agree to abide by its provisions.

Project Name: Project Number:

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

ATTACHMENT 2

CH2MHILL

Ordnance Explosives (OE) Standard of Practice HSE- 91

Note:

This Standard of Practice covers the entire spectrum of OE/UXO-related project activities, including investigation and removal.

For this specific project, "Initial Ordnance and Explosives Site Assessment for the Blue and Red Beach Areas," the removal tasks described in Sections 4.2.2.(b), 4.2.3.(d), and 4.2.7 of this Standard of Practice will be conducted by NSRR EOD personnel and may not apply to this project.

CH2MHILL

Ordnance Explosives (OE) Standard of Practice HSE-91

1.0 Applicability and Scope

1.1 Applicability

This Standard of Practice (SOP) applies to: (1) CH2M HILL employees who enter areas known or suspected of having Ordnance Explosives (OE) and (2) CH2M HILL Safety Coordinators (SCs) and CH2M HILL EE&SBG Unexploded Ordnance Safety Officers (UXOSO) who may be responsible for providing oversight of a subcontractors OE operations. OE operations may be conducted on active, inactive, closed, transferring, or transferred ranges; former battlefields; disposal sites; or munitions manufacturing and storage sites.

1.2 Scope

This SOP provides information regarding the spectrum of hazards and issues to be addressed during each phase of a project associated with OE operations. OE hazards addressed in this SOP include exposure to Unexploded Ordnance (UXO), Chemical Warfare Material (CWM), explosives contaminated soil and groundwater, and the hazards associated with operations to locate, identify, remove, and dispose of OE. CH2M HILL employees who enter OE areas must take precautions to avoid these hazards and be aware of associated safe work practices.

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, responsibilities for health, safety and environment (HS&E) are expressly defined through the subcontract terms and conditions, and CH2M HILL's HS&E practices in the field are determined based on these defined responsibilities. Consistent with HSE-55, the subcontractor must determine how to operate safely and in compliance with applicable HS&E regulations and industry standards, and how to correct deficiencies. CH2M HILL employees shall not direct the means and methods of OE operations nor direct the details of corrective actions.

1.3 Regulatory Review

OE projects are often complex and have a myriad of regulatory requirements to ensure safety. Support for determining the governing laws and regulations for any specific OE project must be reviewed by the EE&SBG UXOSO to ensure compliance and safety.

Department of Defense (DOD) Ammunition and Explosives Safety Standards, DOD 6055.9-STD, establishes uniform safety standards applicable to ammunition and explosives, to associated personnel and property, and to unrelated personnel and property exposed to the potential damaging effects of an accident involving ammunition and explosives during their development, manufacturing, testing, transportation, handling, storage, maintenance, demilitarization, and disposal.

The U.S. Environmental Protection Agency (EPA) regulates the disposal of military munitions and waste containing military munitions through the Military Munitions Rule (RCRA; 40 CFR part 266, subpart M). The rule (1) identifies when conventional and chemical military munitions become a solid waste and (2) provides criteria for storage and transportation of such waste, including a conditional exemption if the munitions are managed under DOD rules.

2.0 Project Planning

2.1 Training Requirements

CH2M HILL employees and subcontractors who work on projects that involve OE must complete the following training:

- 40-hour hazardous waste comprehensive course with training in hazard recognition and basic health and safety issues, as required by the occupational safety and health regulations contained in 29 CFR 1910.120(e)
- Annual 8-hour hazardous waste refresher course
- Hazardous waste supervisory training as specified in 29 CFR 1910.120(e) [only required for management and supervisors]
- All UXO personnel will be graduates of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD; U.S. Naval EOD School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal AL; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DOD-certified equivalent course

The EE&SBG UXOSO can provide assistance in reviewing subcontractor personnel qualifications.

2.2 Medical Surveillance Requirements

All CH2M HILL employees who work on OE sites must be on a medical surveillance program consisting of a baseline health assessment that includes a medical and occupational history review, blood and urine tests for contaminants of interest, electrocardiogram, slit-lamp corneal examination, pulmonary function tests, chest x-ray, respiratory fit test, and a general physical examination that includes hearing and vision.

Employees who terminate employment and who have worked at OE project sites may be required to undergo an exit examination equivalent to the baseline health assessment.

Subcontractors are responsible for ensuring that their employees receive medical surveillance as required.

2.3 Drug Abuse Surveillance Requirements

CH2M HILL employees who perform OE operations and oversight are subject to the provisions contained in HSE-76.

2.4 Competent Person Requirements

OE/UXO subcontractors are responsible for providing a competent person to oversee OE operations. A competent person may be a Senior UXO Supervisor, UXO Safety Officer, UXO Quality Control Specialist, or a UXO Technician III. The competent person must meet the following minimum qualification requirements:

- Be a graduate of either of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD; U.S. Naval EOD School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal Alabama; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DOD-certified equivalent course
- Have at least 10 years of combined active duty military EOD and contractor UXO experience
- Have experience in OE clearance operations and supervising personnel

CH2M HILL competent person requirements are the same as for a subcontractor.

2.5 Safety Equipment

OE subcontractors are responsible for providing all personal protective equipment (PPE) necessary for their employees. CH2M HILL will provide PPE only for its own employees. Other safety equipment will be provided as delineated in the subcontract and referenced documents. The EE&SBG UXOSO must review subcontractor work plans and health and safety plans to ensure that appropriate safety equipment has been included to meet the scope of work requirements.

2.6 Subcontractor Selection

OE subcontractors are selected as described in the "Subcontractor, Contractor, and Owner" SOP HSE-55. The "Subcontractor Safety Procedure Criteria—OE Operations" found in Attachment 1 provides the minimum criteria for OE operations. Additional criteria may be developed dependent upon the specific OE scope of work requirements for the subcontractor. These criteria shall be used by the CH2M HILL EE&SBG UXOSO to review subcontractor OE procedures submitted when oversight is required by HSE-55.

2.7 Planning Activities

Assistance for planning OE operations is available from the CH2M HILL EE&SBG UXOSO for planning and executing OE support for Hazardous Toxic Radiological Waste (HTRW) support activities, construction support activities, OE response actions, CWM activities, explosive contaminated soils, and ordnance demilitarization. The following types of support may be needed for OE operations:

- On a HTRW site with known or suspected OE, UXO support refers to the anomaly avoidance techniques implemented to avoid any potential surface UXO and any subsurface anomalies.
- On a construction site with known or suspected OE, UXO support is provided by qualified UXO personnel during construction activities. The level of UXO support required is dependent on the probability of encountering UXO, as determined on a project-by-project basis.
- OE response actions in which location, identification, excavation, removal, and disposal of UXO is accomplished require qualified UXO personnel, including a Senior UXO Supervisor, UXO Safety Officer, and UXO Quality Control Specialist to provide oversight for UXO Teams performing operations.
- On an OE site that has OE contamination of soils and/or groundwater, UXO support may include both anomaly avoidance techniques and OE construction support for excavation and/or treatment of OE contaminated soil and groundwater.
- On ordnance demilitarization and CWM projects, OE support may be needed for identification, handling, disassembly, processing, transportation, and treatment or disposal of munition components.
- On projects where OE waste (OEW) is transported or disposed off-range, the UXO and Environmental Compliance Coordinator (ECC) may assist in identifying the applicable regulations and permits required.
- On projects where Ordnance Related Scrap (ORS) or inert ordnance is recovered and processed for disposal as scrap, UXO and ECC support may determine if incineration and certification is required, along with any permitting requirements for portable incinerator operation.

The CH2M HILL EE&SBG UXOSO or EE&SBG UXO Quality Control Specialist shall verify subcontractor training and current medical examinations prior to the start of field operations.

3.0 Definitions

3.1 Active Range. A military range that is currently in use and being regularly used for range activities.

3.2 Anomaly. Any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and nonferrous material at a site.

3.3 Anomaly Avoidance. Techniques employed by EOD or UXO personnel at sites with known or suspected OE to avoid any potential surface UXO or subsurface anomalies. This usually occurs at mixed hazard sites when HTRW investigations must occur prior to execution of an OE removal action. Intrusive anomaly investigations are not authorized during ordnance avoidance operations.

3.4 Chemical Warfare Materials (CWM). An item configured as a munition containing a chemical substance that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. Also includes V- and G-series nerve agents, H-series blister agent, and lewisite in other-than-munition configurations. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered CWM. CWM does not include: riot control agents, chemical herbicides, smoke and flame producing items, or soil, water, debris, or other media contaminated with a chemical agent.

3.5 OE Construction Support. Support provided by qualified UXO personnel during construction activities at potential OE sites to ensure the safety of construction personnel from the harmful effects of UXO. When a determination is made that the probability of encountering UXO is low (current or previous land use leads to a determination that OE may be present), a two person UXO team will stand by in case the construction contractor encounters a suspected UXO. When a determination is made that the probability of encountering a UXO is moderate to high (current or previous land use leads to a determination that OE was employed or disposed of in the parcel of concern, e.g., open burn and open detonation areas), UXO teams are required to conduct subsurface UXO clearance for the known construction footprint either in conjunction with the construction contractor or prior to construction.

3.6 EOD Personnel. EOD personnel are those active duty military individuals performing EOD operations.

3.7 Explosive Ordnance Disposal (EOD). EOD includes the detection, identification, field evaluation, rendering safe, and final disposal of OE.

3.8 Explosive Safety Submission (ESS). The document that serves as the specifications for conducting work activities at the project. The ESS details the scope of the project, the planned work activities, and potential hazards and the methods for their control.

3.9 Explosive Soil. Refers to mixtures of explosives in soil, sand, clay, or other solid media at concentrations such that the mixture itself is explosive.

(a) The concentration of a particular explosive in soil necessary to present an explosion hazard depends on whether an explosive is classified as "primary" or "secondary."

(b) Primary explosives are those extremely sensitive explosives (or mixtures thereof) that are used in primers, detonators, and blasting caps. They are easily detonated by heat, sparks, impact, or friction. Examples of primary explosives include lead azide, lead styphnate, and mercury fulminate.

(c) Secondary explosives are bursting and boostering explosives (i.e., they are used as the main bursting charge or as the booster that sets off the main bursting charge). Secondary explosives are much less sensitive than primary explosives.

(d) Soil containing 10 percent or more by weight of any secondary explosive mixture of secondary explosives is considered "explosive soil."

(e) Soil containing propellants (as opposed to primary or secondary high explosives) may also present explosion hazards.

3.10 Inactive Range. A military range that is not currently being used, but that is still under military control and considered by the military to be a potential range area, and that has not been put to a new use that is incompatible with range activities.

3.11 Intentional Detonation. An intentional detonation is a planned, controlled detonation.

3.12 Intrusive Activity. An activity that involves or results in the penetration of the ground surface at an area known or suspected to contain OE. Intrusive activities can be of an investigative or removal action nature.

3.13 Maximum Credible Event. The worst single event that could occur at any time, with maximum release of a chemical agent from a munition, container, or process as a result of unintended, unplanned, or accidental occurrence.

3.14 Most Probable Event (MPE). The most likely event, as a result of an accidental, unplanned, or unintended detonation of an item of ordnance, that could occur during OE activities. The event must be realistic with reasonable probability of occurrence.

3.15 Most Probable Munition (MPM). The OE item that has the greatest hazard distance based on calculations of the explosion effects of the OE items anticipated to be found at a site. Typically, the MPM is the OE item with the greatest fragmentation or overpressure distance based on the type of OE items that were historically used at the site.

3.16 Military Munitions. All ammunition products and components produced or used by or for the U.S. DOD or the U.S. Armed Services for national defense and security, including military munitions under the control of the DOD, the U.S. Coast Guard, the U.S. Department of Energy (DOE), and the National Guard personnel. The term military munitions includes: confined gases, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DOD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.

3.17 Military Range. Designated land and water areas set aside, managed, and used to conduct research on, develop, test, and evaluate military munitions and explosives, other ordnance or weapons systems, or to train military personnel in their use and handling. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, and buffer zones with restricted access and exclusionary areas.

3.18 Non-Stockpile Chemical Warfare Materials. CWM (defined above) that is not included in the chemical stockpile. Nonstockpile CWM is divided into five categories:

(1) Buried CWM.

(2) Recovered chemical weapons (items recovered during range clearing operations, from chemical burial sites, and from research and development testing).

(3) Former chemical weapon production facilities.

(4) Binary chemical weapons.

(5) Miscellaneous CWM (unfilled munitions and devices and equipment specially designed for use directly in connection with employment of chemical weapons).

3.19 Ordnance and Explosives (OE) consists of:

(1) Ammunition, ammunition components, chemical or biological warfare materials that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried or fired. Such ammunition, ammunition components, and explosives are no longer under accountable record control of any DOD organization or activity.

(2) Explosive Soil. See definition under "explosive soils."

(3) OE market includes: Unexploded Ordnance (UXO), Chemical Weapons Materials (CWM), OE Contaminated Soils and Groundwater, Range Maintenance, Ordnance Demilitarization (Demil), and Demining (DM).

3.20 Quantity-Distance (QD). The quantity of explosives material and distance separations that provide defined types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate Q-D tables provided in DOD 6055.9-STD. Separation distances are not absolute safe distances but are relative protective safe distances. Greater distances than those shown in the Q-D tables shall be used whenever possible.

3.21 Removal Action. The cleanup of OE from the environment to include the disposal of removed material. The term includes, in addition, without being limited to, security fencing or other measures to prevent, minimize, or mitigate damage to the public health or welfare or the environment.

3.22 Response Action. Action taken instead of or in addition to a removal action to prevent or minimize the release of OE so that it does not cause substantial danger to present or future public health or welfare or the environment.

3.23 Senior UXO Supervisor (SUXOS). Supervises all contractor onsite UXO activities. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen proving Ground, MD, or the U.S. Naval EOD School, Indian Head, MD. This individual must have at least 15 years of combined active duty military EOD and contractor UXO experience, to include at least 10 years in supervisory positions.

3.24 Unintentional Detonation. A detonation not planned in advance.

3.25 Unexploded Ordnance (UXO). Military munitions that have been primed, fuzed, armed, or otherwise prepared for action, and have been fired dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remain unexploded either by malfunction, design, or any other cause.

3.26 UXO Personnel. Contractor personnel who have completed specialized military training in EOD methods and have satisfactorily performed the EOD function while serving in the military. Various grades and contract positions are established based on skills and experience.

3.27 UXO Safety Officer (UXOSO). Contractor personnel with the responsibility of enforcing the contractor's SSHP. This individual must, therefore, be in the field whenever possible to observe operations. This individual must have the same minimum qualifications as the UXO Technician III. In addition, this individual must have the specific training, knowledge, and experience necessary to implement the SSHP and verify compliance with applicable safety and health requirements.

3.28 UXO Technician III. Supervises a UXO team. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, the U.S. Naval EOD School, Indian Head,

MD, or U.S. Naval EOD School, Elgin Air Force Base, FL, or a DOD-equivalent certified course. This individual must have a minimum of 10 years of military EOD or contractor UXO experience.

3.29 UXO Technician II. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, the U.S. Naval EOD School, Indian Head, MD, or U.S. Naval EOD School, Elgin Air Force Base, FL, or a DOD-equivalent certified course. This individual must have a minimum of 5 years of military EOD or contractor UXO experience.

4.0 Project Execution

4.1 Safe Work Practices

The requirements of this section are to be followed by CH2M HILL employees who enter OE exclusion zones, regardless of the company performing OE operations. These requirements also pertain to OE subcontractor personnel when CH2M HILL is providing oversight.

4.2 Regulations/Industry Standards

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, CH2M HILL's project EE&SBG UXOSO may be required to provide oversight of an OE subcontractor. OE subcontractors retain control over their practices, and CH2M HILL's oversight does not relieve them of their own responsibility for effective implementation and enforcement of HS&E requirements. The following subsections provide the minimum regulatory and industry standard requirements pertaining to OE operations.

4.2.1 General Safety Concerns and Procedures

(a) OE operations will not be conducted until a complete plan for the site is prepared and approved by the CH2M HILL EE&SBG UXOSO. These plans will be based upon limiting exposure to the minimum number of personnel, for the minimum amount of time, to the least amount of OE consistent with safe and efficient operations.

(b) Only UXO qualified personnel will perform OE procedures. Non-UXO personnel may be used to perform OE-related procedures when supervised by a UXO Technician III. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III.

(c) Personnel who will be handling OE items will not wear outer or inner garments having static electricity-generating characteristics. Materials made of 100 percent polyester, nylon, silk, and wool are highly static producing.

(d) UXO Technicians are required to wear hard hats except when investigating suspect UXO. Hard hats may create an unsafe condition by falling off of the head of a UXO technician at a critical moment. In the event of the accidental detonation of a UXO (the worst case accident scenario), the hard hat will not protect the UXO technician from fragments and may worsen the injury by reflecting fragments into the head of the technician. This is consistent with safety guidance from the U.S. Army Corps of Engineers OE Center of Excellence. Also, protective shoes worn by personnel performing UXO operations should be constructed of nonferrous materials (e.g., fiberglass) to prevent interference with sensitive geophysical instruments.

(e) Prior to any action being performed on an ordnance item, all fuzing will be positively identified. This identification will consist of fuze type by function, condition (armed or unarmed), and the physical state/condition of the fuze, i.e., burned, broken, parts exposed/sheared, etc.

4.2.2 OE Safety Precautions

(a) Every effort will be made to identify a suspect OE item. Under no circumstances will any OE be moved in an attempt to make a positive identification. The OE item will be visually examined for markings and other external features such as shape, size, and external fittings. If an unknown OE item is encountered, the CH2M HILL EE&SBG UXOSO will be notified immediately. The following are additional considerations for the safe handling of OE items:

(1) Projectiles containing base detonating (BD) fuzes are to be considered armed if the round is fired.

(2) Arming wires and pop-out pins on unarmed fuzes should be secured prior to any movement.

(3) Do not depress plungers, turn vanes, rotate spindles, levers, setting rings, or other external fittings on OE items. Such actions may arm or activate the OE.

(4) Do not attempt to remove any fuzes from the OE. Do not dismantle or strip components from any OE items unless the item is included in the scope of work (SOW).

(5) UXO personnel are not authorized to inert any OE items found onsite unless it is a part of the SOW.

(6) OE/UXO items will not be taken from the site as souvenirs/training aids.

(7) Civil War ordnance will be treated as any other OE.

(b) Prior to entering U.S. Army-controlled areas/ranges contaminated with Improved Conventional Munitions (ICM), an approved Department of the Army (DA) wavier must be obtained.

(c) Any time suspect chemical warfare material (CWM) is encountered during conventional OE site activities, all work will immediately cease. Project personnel will withdraw along cleared paths upwind from the discovery. A team consisting of two personnel will secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. The local point of contact designated in the Work Plan will be immediately notified.

(d) Avoid inhalation and skin contact with smoke, fumes, and vapors of explosives and other related materials.

(e) Consider OE items that have been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents, which might render them more sensitive than their original state.

(f) Do not rely on the color coding of OE for positive identification. Munitions having incomplete or improper color codes have been encountered.

(g) Avoid approaching the forward area of an OE item until it can be determined whether or not the item contains a shaped charge. The explosive jet, which is formed during detonation, can be lethal at great distances. Assume that all shaped charge munitions contain piezoelectric (PZ) fuzing system until identified. PZ is extremely sensitive. It can function at the slightest physical change and can remain hazardous for an indefinite period of time.

(h) Approach an unfired rocket motor from the side at a 45-degree angle. Accidental ignition can cause a missile hazard and hot exhaust.

(i) Do not expose unfired rocket motors to any electromagnetic radiation (EMR) sources.

(j) Consider an emplaced landmine armed until proven otherwise. It may be intentionally booby-trapped to deceive.

(k) Assume that practice OE contains a live charge until it can be determined otherwise. Expended pyrotechnic and practice devices can contain red or white phosphorous residue. Due to incomplete combustion, the phosphorous may reignite if the crust is broken and exposed to air.

(l) Do not approach a smoking white phosphorous (WP) munition. Burning WP may detonate the explosive burster charge at anytime.

(m) Foreign ordnance was returned to the United States for exploitation and subsequent disposal. Every effort must be made to research the applicable documentation and publications prior to commencement of a project.

4.2.3 OE Storage

(a) During OE projects, explosive storage falls into two categories, on-DOD installations and off-DOD installations.

(b) For On-DOD installations the provisions of DOD 6055.9-STD will be followed.

(c) In the event the installation does not have an existing storage facility, the provisions of DOD 6055.9-STD will apply.

(d) For Off-DOD installations, establish a temporary explosive storage area that will meet all local, state, and 27 CFR, Bureau of Alcohol Tobacco, and Firearms (BATF) requirements and as much of DOD 6055.9-STD as is practical to implement. The establishment of a temporary explosive storage area must meet the following requirements:

(1) The area will, if possible, meet the inhabited building and public traffic route distances specified in DOD 6055.9-STD. If the distances are less than required by the DOD guidance, a proposed barricading plan to protect the public from accidental detonation must be developed and reviewed by the CH2M HILL Corporate UXOSO.

(2) Magazines must meet the requirements of the BATF regulations, and each magazine must have a Net Explosive Weight (NEW) established for the explosives to be stored.

(3) Each magazine must be grounded as specified in NFPA 780 and must meet the intermagazine distances as defined in the DOD guidance.

(4) A physical security survey will be conducted to determine if fencing or guards are required. This survey will be coordinated through the CH2M HILL EE&SBG UXOSO and local law enforcement agencies.

(5) A fire plan for either on- or off-installation explosive storage areas will be prepared and coordinated through the CH2M HILL EE&SBG UXOSO and the local fire department. All magazines will have placards.

(e) OE Waste (OEW) may be stored: (1) in RCRA regulated units (i.e., tanks, containers, containment buildings, etc.) as described in HSE-80; (2) in military magazines conforming to DDESB standards (as described above); or (3) under the MMR conditional exemption (40 CFR 266.205). The MMR conditional exemption applies to military non-chemical munitions, and the following procedures must be met:

(1) Follow DDESB requirements for storage.

(2) Notify EPA of the location of the unit within 90 days of when storage unit first is used for waste munitions storage.

(3) Notify EPA within 24 hours of any loss or theft of munitions from the storage area.

(4) Inventory wastes annually, conduct inspections quarterly and keep records for at least three years.

(5) Limit access to the area to appropriately trained and authorized personnel.

4.2.4 OE Transportation

In the event that OE items must be transported offsite, the provisions of 49 CFR, DA Pam 385-64 state and local laws must be followed. These additional considerations are provided for the safe transport of OE items:

(a) Do not transport WP munitions unless they are immersed in water, mud, or wet sand.

(b) If loose pyrotechnic, tracer, flare, or similar mixtures are to be transported, they will be placed in #10 mineral oil or equivalent to minimize the fire and explosion hazards.

(c) Incendiary loaded munitions should be placed on a bed of sand and covered with sand to help control the burn if a fire should start.

(d) If a base-ejection projectile must be transported to a disposal area, the base will be oriented in the vehicle so that it is parallel to the rear axle. This will afford maximum protection for the personnel operating the vehicle.

(e) OE with exposed hazardous fillers such as high explosives (HE), will be placed in appropriate containers with packing materials to prevent migration of the hazardous fillers. Padding should be added to protect the exposed filler from heat, shock, and friction.

4.2.5 OE Exclusion Zone Operations

On OE project sites, it is the responsibility of the UXOSO to establish the exclusion zone for each UXO team. This exclusion zone should not be confused with the safe separation distance that is maintained between teams.

(a) The purpose of the exclusion zone is for the protection of nonessential project personnel and the public from blast overpressure and fragmentation hazards. There are two criteria for calculating exclusion zones:

(1) Intentional Detonations. When destroying ordnance, both the hazards from fragmentation and overpressure must be considered. The minimum separation distances in DOD 6055.9-STD will also be used unless otherwise stated.

(2) Unintentional Detonations. If the identification of OE on an OE site is unknown, the minimum separation specified in DOD 6055.9-STD, Chapter 5, Paragraph C5.5.4, will be used to establish the exclusion zones.

(b) When multiple teams are working onsite, a safe separation distance will be established. The minimum distance maintained between teams will never be less than 200 feet or the K50 overpressure distance. The one that is greater will be used.

(c) While OE operations are being conducted, only personnel essential for the operation will be allowed in the exclusion zone. When nonessential personnel enter the exclusion zone, all OE operations will cease. In addition to this work stoppage, the following actions will be accomplished:

(1) The individuals must receive a safety briefing and sign the visitors' log prior to entering the zone.

(2) The individuals will be escorted by a UXO qualified individual.

(3) All OE operations will cease within the radius of the exclusion zone for the areas to be visited.

(d) All personnel working within the exclusion zone must comply with the following:

(1) There will be no smoking within the exclusion zone, except in areas designated by the UXOSO.

(2) There will be no open fires for heating or cooking within the exclusion zone, except where authorized by the UXOSO.

(3) During magnetometer operations, workers will have no metal parts in or on their shoes that would cause the magnetometer to present false indications.

4.2.6 OE Excavation Operations

(a) Hand excavation is the most reliable method for uncovering OE, provided the item is near the surface. Hand excavation exposes personnel to the hazard of detonation for longer periods of time than any other method. Taking this into consideration, only UXO qualified personnel will be used to accomplish this task.

(b) Earth-Moving Machinery (EMM) may be used to excavate overburden from suspected OE. EMM will not be used to excavate within 12 inches of a suspected OE. Once the EMM is within 12 inches of the OE, the excavation will be completed by hand excavation methods. Personnel who are not UXO qualified may operate EMM only when supervised by a UXO Technician III.

(1) If more than one EMM is to be used onsite, the same minimum separation distances required for multiple work teams applies.

(2) EMM operations will be conducted within the guidelines of HSE-32 "Excavations."

(c) Excavation operations, whether by hand or EMM, will employ a step-down or offset access method. Under no circumstances will any excavation be made directly over the suspected OE.

4.2.7 OE Disposal Operations

To avoid MMR regulation, all demolition operations will be conducted on-range in accordance with TM/EODB 60A 1-1-31. Any deviation from this policy must be approved by the UXOSO and ECC. The following are on-range disposal procedures.

(a) As a general rule, all demolition operations will be accomplished by use of shock tubing or electrical means to assure maximum safety. There are exceptions to this requirement in situations where static electricity of EMR hazards are present.

(b) The only acceptable disposal method is the one stated in the appropriate TM/EODB 60-series manual for specific ordnance types. Any commercial explosives being used will be equivalent to the military explosive required for the disposal operation.

(c) If a situation dictates, protective measures to reduce shock, blast overpressure, and fragmentation will be taken. The CH2M HILL EE&SBG UXOSO will assist in any design work and must review and approve all proposed protective works. As a minimum requirement, all demolition shots will be tamped with clean earth or sand. In accordance with DOD 6055.9-STD the following separation distances will be observed unless otherwise directed:

(1) Minimum separation distance for nonfragmenting explosive materials will be no less than 1,250 feet.

(2) Minimum separation distance for fragmenting explosive ordnance will be no less than 2,500 feet. For bombs and projectiles with a diameter of 5 inches or greater, use a minimum distance of 4,000 feet.

(3) Ordnance items with lifting lugs, strong backs, base plates, etc., will be oriented away from personnel, as fragments from these items tends to travel farther than normal.

(d) Once demolition operations are completed, a thorough search of the demolition area will be conducted with a magnetometer to ensure a complete disposal was accomplished.

(e) Inert ordnance will not be disposed of for scrap until the internal fillers/voids have been exposed and unconfined. Heat generated during the reclamation process can cause the inert fillers, moisture, or air to expand and burst the sealed casings. In this situation, Oil Well Perforators can be used for venting these ordnance items that require demilitarization.

(f) Inert ordnance to be disposed of as scrap may require certification by the UXOSO and a government representative. This may require further treatment by operation of a portable incinerator, depending on local requirements and acceptance criteria. The UXOSO and ECC will determine if certification and incineration is necessary, along with any permitting requirements during project planning.

4.2.8 OEW Disposal

When the used or fired munition is managed off-range (i.e., transported off-range and stored, reclaimed, treated or disposed) or disposed of on-range (i.e., buried without treatment), it is subject to regulation as a solid waste under RCRA. This means it may also be subject to regulation as a hazardous waste. Also, munitions that land off-range, and that are not promptly retrieved, are solid wastes. Table 4-1 describes how solid wastes may be characterized as hazardous in these situations. All characterization must be based on field observations by the EE&SBG UXOSO, who is trained in the proper identification of waste ordnance items and meet the requirements for an "emergency response expert" under RCRA. In the event the OEW is regulated as hazardous waste, refer to the Hazardous Waste Management SOP, HSE-80 for RCRA hazardous waste management requirements.

Table 4-1. Waste Characterization

Item	Characterization	Waste Code
Uncontaminated Metal Debris	If visual inspection determines if item does not contain waste residue, waste is non-hazardous scrap metal, excluded from RCRA regulation under 40 CFR 261.6(a)(3). Waste may be subject to further incineration and certification requirements.	None
Contaminated Metal Debris	If visual inspection determines item contains hazardous waste residue, manage as potential hazardous waste.	Potential D003 and/or D008
Ordnance Items Less than 0.5 Caliber	Small-arms ammunition is not considered reactive hazardous waste in accordance with EPA policy (November 30, 1984 Memorandum, John Skinner, OSWER Director).	None
Ordnance Items Greater than 0.5 Caliber	Untreated UXO presumed to be reactive hazardous waste using generator knowledge under 40 CFR 261.23.	D003
Ordnance Items Greater than 0.5 Caliber with Lead Projectiles	Ordnance containing lead projectiles will be presumed to be toxic hazardous waste under 40 CFR 261.24.	D008

4.2.9 Forms/Permits

(a) **Type-33 User of High Explosives License/Permit** issued by the BATF? is required for the purchase, storage, and use of high explosives (HE) in support of OE operations, construction projects, and demolition and disposal (D&D) projects. Written authorization designating the individuals who can purchase, store, or use explosives must be included in the site-specific work plans.

(b) **State and Local Explosive Permits** may be required for the purchase, storage, and use of HE in support of OE operations, construction projects, and D&D projects.

4.2.10 Self-Assessment Checklists

The "HS&E Self-Assessment Checklist—OE Operations" found in Attachment 2 is provided as a method of verifying compliance with established safe work practices, regulations, and industry standards pertaining to OE operations. CH2M HILL's project UXOSO/EE&SBG UXOSO shall use this checklist when: (1) CH2M HILL employees are potentially exposed to hazards associated with OE operations, and/or (2) CH2M HILL oversight of an OE subcontractor is required. The EE&SBG UXOSO shall specify the frequency in which this checklist shall be completed and provide this information in the project's written safety plan. Completed checklists shall be sent to the EE&SBG UXOSO for review. The EE&SBG UXOSO shall assist the Site UXOSO in resolving any deficiencies identified during the self-assessment.

Attachments

Attachment 1: Subcontractor Safety Procedure Criteria for OE Operations

Attachment 2: H&S Self-Assessment Checklist for OE Operations

Ordnance Explosives (OE)

Standard of Practice HSE-91

Attachment 1: Subcontractor Safety Procedure Criteria for OE Operations

Ordnance Explosives (OE)
Standard of Practice HSE-91

Attachment 2: HS&E Self-Assessment Checklist—OE Operations

CH2MHILL

HS&E Self-Assessment Checklist - ORDANCE EXPLOSIVES (OE)

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI. The Safety Coordinator (SC) position must be filled by a qualified UXO technician to provide field assessment of OE activities.

This checklist is to be used at locations where: 1) CH2M HILL employees are involved with OE activities (complete entire checklist). 2) CH2M HILL oversight of an OE subcontractor is required (complete entire checklist).

UXOSO's may consult with OE subcontractors when completing this checklist, but shall not direct the means and methods of OE operations nor direct the details of corrective actions. OE subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to OE hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with OE HS&E requirements
Subcontractor Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the OE subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-91.

SECTION 1	Yes	No	N/A	N/O
PROJECT PLANNING (2.0)				
1. CH2MHILL employees and sub contractors have completed the training requirements.	☐	☐	☐	☐
2. All UXO personnel are qualified as UXO.	☐	☐	☐	☐
3. CH2MHILL employees and sub contractors have met the requirement for medical surveillance.	☐	☐	☐	☐
4. CH2MHILL employees and sub contractors have participated in the drug screening program..	☐	☐	☐	☐
5. A qualified OE/UXO competent person is assigned to oversee OE operations	☐	☐	☐	☐
6. Site personnel are wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐
7. Project plans address the required support needed for OE operations	☐	☐	☐	☐

CH2MHILL

HS&E Self-Assessment Checklist - ORDANCE EXPLOSIVES (OE)

SECTION 2	Yes	No	N/A	N/O
GENERAL SAFETY CONCERNS and PROCEDURES (4.2.1)				
6. OE operations are being conducted with approved plans.	☐	☐	☐	☐
7. Only qualified UXO technicians or Explosive Ordnance Disposal (EOD) personnel will locate, identify, handle, remove, transport, store or dispose of OE/UXO items	☐	☐	☐	☐
8. Proper PPE is being worn as required in the HASP	☐	☐	☐	☐
OE SAFETY PRECAUTIONS (4.2.2)				
9. Ordnance items are being properly identified, classified and safely handled.	☐	☐	☐	☐
10. OE/UXO items are not taken off site as souvenirs.	☐	☐	☐	☐
11. Personnel know and understand the procedures if CWM is encountered.	☐	☐	☐	☐
12. Approach routes of OE/UXO items are being properly observed.	☐	☐	☐	☐
13. OE/UXO safety precautions are being observed	☐	☐	☐	☐
OE STORAGE/TRANSPORTATION (4.2.3-4.2.4)				
14. OE Storage is in compliance with plans and directives	☐	☐	☐	☐
15. OE Storage meets minimum physical security standards	☐	☐	☐	☐
16. OEW is properly identified, classified and stowed	☐	☐	☐	☐
17. OE is properly transported in appropriate containers and vehicles	☐	☐	☐	☐
OE EXCLUSION ZONES (4.2.5)				
17. OE Exclusion Zones (EZ) established	☐	☐	☐	☐
18. Multiple UXO teams working onsite have safe separation	☐	☐	☐	☐
19. Only essential personnel are allowed in the exclusion zone	☐	☐	☐	☐
20. When non-essential personnel enter the EZ, OE activities are stopped and an escort provided	☐	☐	☐	☐
OE EXCAVATION OPERATIONS (4.2.6)				
21. Hand excavation methods are used to excavate from 12 inches to OE item	☐	☐	☐	☐
22. Earth Moving Machinery (EMM) is used to excavate overburden (greater than 12 inches)	☐	☐	☐	☐
23. Earth Moving Machinery (EMM) excavations are supervised by a qualified UXO Technician	☐	☐	☐	☐
24. All OE excavations employ a step down off set method.	☐	☐	☐	☐
OE DISPOSAL OPERATIONS (4.2.7)				
25. Proper demolition procedures are being observed	☐	☐	☐	☐
26. OE sub contractor conducting disposal, has proper explosive license/permits	☐	☐	☐	☐
27. Protective measures are taken to reduce shock, blast over pressure and fragmentation	☐	☐	☐	☐
28. Minimum safe separation distances are established	☐	☐	☐	☐
29. OE accountability is tracked "Cradle to Grave" as required	☐	☐	☐	☐
OEW DISPOSAL (4.2.8)				
30. OEW is properly characterized	☐	☐	☐	☐
31. OEW is properly stored treated and disposed of	☐	☐	☐	☐
32. OEW accountability is tracked "Cradle to Grave" as required	☐	☐	☐	☐

HS&E Self-Assessment Checklist - ORDANCE EXPLOSIVES (OE)

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

ATTACHMENT 3

CH2MHILL

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: NASD Vieques **Project Number:**

MSDSs will be maintained at the following location(s): No chemicals are expected to be used as part of the OE surveys and removals. If chemicals are brought to the site for use during the investigation, the chemicals will be added to this form and the appropriate MSDS Sheets will be attached to this plan.

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard

Refer to SOP HS-05 Hazard Communication for more detailed information.

ATTACHMENT 4

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Location: Project # :

HCC: Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility / project hazard communication file.

ATTACHMENT 5: APPLICABLE MATERIAL SAFETY DATA SHEETS

ATTACHMENT 6: LEAD AWARENESS

Lead Exposure Training Instructions

This module was designed for employees who work in areas with percent levels of inorganic lead or areas where there is a potential lead exposure above the action level of 30 micrograms per cubic meter ($\mu g / m^3$).

Lead Exposure Training Program

The OSHA lead standard (29 CFR 1910.1025) requires employers to provide lead training for those employees who may be exposed to inorganic lead above the action level of 30 $\mu g / m^3$. This training program satisfies this OSHA requirement and is provided to assist employees in recognizing lead exposure hazards and understanding the procedures to be followed to minimize exposure.

Objectives

- Inform employees of the possible adverse health effects of lead exposure
- Inform employees of the regulatory requirements when working with or around lead
- Identify how lead exposures could occur on CH2M HILL projects

How to complete this training

Employees are required to read the training materials that follow and complete a short quiz. The training materials must be read thoroughly and understood before completing the quiz; you will have only one chance at answering each question.

Quiz scores will automatically be sent to the Health and Safety Training Administrator. A minimum score of 70 percent must be obtained to receive credit for this training. If a passing score is obtained, the H&S Training Administrator will issue you a certificate of completion. If a passing score is not obtained, you are required to contact your regional health and safety program manager to discuss the training material directly.

Lead Exposure Training

1. Uses And Occurrences

Lead is a well-known naturally-occurring metal found in the earth's crust, often associated with silver and zinc. It has had a variety of uses since antiquity, but its greatest use today is in car batteries. It was formerly used in gasoline, water pipes, pottery glazes, paint, solder, and as metal alloy. It currently has a variety of other uses such as radiation shielding, as vibration dampening material, in explosives, bullets, magnets, and in electronic equipment. It is also a common contaminant at hazardous waste sites.

2. Physical Characteristics

Lead exists as the familiar soft, dull gray metal, as a white or red solid as lead oxide, a gray or black solid as lead sulfide (galena), a white solid as lead sulfate, all which are insoluble in water. Numerous other forms of inorganic lead exist. The organic forms, tetraethyl lead and tetramethyl lead, used in the past in fuels, are flammable colorless liquids also insoluble in water.

3. Toxicity and Hazards

Lead is a highly toxic substance that has a variety of adverse health effects from both chronic and acute exposure. An acute exposure to high levels of lead can cause a brain condition known as encephalopathy which can lead to death in a few days. The more common chronic exposure can also cause brain damage, blood disorders (anemia), kidney damage, damage to the reproductive system of both men and women, and toxic effects to fetuses. Lead is stored in the bones and eliminated from the body very slowly. Consequently, exposures to low levels over many years can cause these adverse health effects. Lead is toxic by inhalation and ingestion, but is not absorbed through the skin. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in mouth, anxiety, insomnia and muscle and joint pain or soreness.

4. Regulations

Inorganic lead has been specifically regulated in general industry by OSHA since 1981 (29 CFR 1910.1025) and in construction (29 CFR 1926.62) since 1994. The 8-hour permissible exposure limit is 50 $\mu g / m^3$. There is no short-term exposure limit. OSHA also specifies an action level of 30$\mu g / m^3$. These limits apply to both general industry and construction. Initial air monitoring must be done whenever there are indications of lead exposure above the action level. If the action level is not exceeded, air monitoring can cease. If the action level is exceeded, initial blood lead level monitoring must be made available. If exposed above the action level for more than 30 days in a year, medical surveillance must be provided which includes further blood lead level monitoring and a medical examination. If specified blood levels are exceeded, the employee must be removed from the job or task where lead exposure occurs. Training must also be provided. If the permissible exposure limit (PEL) is exceeded, engineering controls must be implemented to reduce exposure. If engineering controls are not feasible or ineffective, respirators must be provided and worn. Air-purifying respirators with high-efficiency (HEPA) filters can be worn when airborne levels are as high as 500 $\mu g / m^3$. If levels exceed this amount, supplied air respirators must be

worn. In addition, if the PEL is exceeded, OSHA requires the establishment of regulated areas, showers, change rooms, separate clean lunchrooms and warning signs. Regulated areas are demarcated from the rest of the workplace to limit access to authorized personnel who have received lead training. To enter a regulated area you must also wear protective clothing. Tetraethyl lead and tetramethyl lead have separate PELs of 100 $\mu g/m^3$ and 150 $\mu g/m^3$, respectively, and are not covered under the inorganic lead regulation.

5. How Exposures Can Occur At CH2M HILL Projects

Exposure to lead can occur at hazardous waste sites where lead is found in soil or groundwater and at old mining sites or former smelter sites. Exposure to lead-containing dust could occur during drilling, heavy equipment movement, or other soil-disturbing activities. Dust formation can be minimized by wetting soils. Exposure could also occur during lead paint removal activities, during welding on metal surfaces with lead-containing paint, or in project work in smelters, battery recycling or manufacturing plants, or at some mines.

6. Additional Information

Persons working at hazardous waste sites with known high amounts of lead in soils (3 percent or 30,000 ppm) should have blood lead draws taken before and after site work. Air sampling should be conducted during soil disturbing activities at the site. Person working at non-hazardous waste sites who have information or suspect they have been exposed to lead above the action level should contact a health and safety manager to determine whether medical monitoring is needed or other regulatory requirements apply.

LEAD QUIZ

1. Which of the following is not a mode of entry of lead?
   A. Inhalation
   B. Ingestion
   C. Skin absorption
   D. All of the above are modes of entry
2. Which of the following is not a common symptom of lead exposure?
   A. Loss of appetite
   B. Metallic taste in mouth
   C. Muscle and joint pain or soreness
   D. All are common symptoms of lead exposure
3. What are the OSHA exposure limits for lead (PEL and action level)?
   A. 50 $\mu g / m^3$ and 25 $\mu g / m^3$ respectively
   B. 50 ppm and 25 ppm respectively
   C. 50 ppm and 30 ppm respectively
   D. 50 $\mu g / m^3$ and 30 $\mu g / m^3$ respectively
4. When is air monitoring required for lead exposures?
   A. When exposed to lead for 30 days or more in a year
   B. Anytime lead is present in the workplace
   C. When there are indications of lead exposure above the action level
   D. When the PEL is exceeded
5. When must medical surveillance be made available for lead exposures?
   A. When the action level is exceeded
   B. When the action level is exceeded for 30 days in a year
   C. When the PEL is exceeded
   D. When the PEL is exceeded for 30 days in a year

6. When is respiratory protection required for lead exposures?

    A. When the action level is exceeded

    B. When the action level is exceeded for 30 days in a year

    C. When engineering controls do not reduce exposure below the PEL

    D. When the PEL is exceeded for 30 days in a year

7. What respiratory protection is considered acceptable for protection against lead exposures?

    A. Air-purifying with organic vapor cartridge

    B. Air-purifying with HEPA cartridge

    C. Air-purifying with lead cartridge

    D. Supplied-air respirator is the only acceptable respiratory protection

8. What are the requirements for entering a lead-regulated area?

    A. Must be an authorized person

    B. Must complete lead training

    C. Must wear protective clothing

    D. All of the above

9. What control measure should be used to minimize dust formation when disturbing lead-containing soil?”

    A. Training

    B. Wetting the soil

    C. Air purifying respirators

    D. None of the above

10. What level of lead in the soil might require a lead blood test?

    A. 1% or 10,000 ppm

    B. 3% or 30,000 ppm

    C. 5% or 50,000 ppm

    D. None of the above

SECTION 5

Location Surveys and Mapping Plan

Survey and mapping tasks are key components of the OE/MEC investigations for identifying the location of each OE and MEC component in the field; for reporting the locations of these components on maps and in spatial queries conducted in the GIS; and for assisting with disposition of OE and MEC components. This Location Surveys and Mapping Plan describes the methods, equipment, and accuracy requirements for location surveys and mapping for the OE and MEC survey and anomaly reacquisition at Blue Beach and Red Beach.

5.1 Surveying

Surveying and anomaly reacquisition at Blue Beach and Red Beach will be conducted by the geophysical subcontractor using GPS or USRADS systems. Protocols for recording, documenting, and integrating the location and OE/MEC attributes with the OE/MEC data management system were described in Section 3 of this Work Plan.

5.2 Mapping

All control points and their corresponding locations, identification, coordinates, and elevations will be stored digitally and will be reproducible for accurate plotting on maps. If required, reproducible Mylar maps will be provided at the scale specified or appropriate for the coverage area requested in the task order. Unless otherwise requested, each map will include a north arrow (grid, true and magnetic) with the differences between grid, true, and magnetic north posted in minutes and seconds. Grid lines or tic marks posted at systematic intervals with their corresponding grid values will be shown on the edges of the maps. The legend will include standard symbols used on the map and a map index showing the relationship of the map to the overall project or site boundary. The state plane coordinates will be established for the corners of each grid area investigated.

GPS technology may be used to locate OE/MEC components if this technology is readily available for use on the project and protocols are in place for recording, documenting, and integrating the location and OE/MEC attributes with the OE/MEC data management system.

5.2.1 Digital Data

The survey information collected will be sufficient to accurately relocate the position of the target components in the field and accurately plot the position of each component on a CAD map, in the GIS, or for use in statistical applications and tabular reports.

An overall planimetric design file will be created and digitized into an Intergraph Microstation .DGN file at an elevation of zero. For contours and spot elevations, all associated data will be digitized into a second Microstation 3-D design file with each element at its correct elevation, and topologically triangulated network (ttn) files will be created to model the topographic surface. The ttn file will be created using elements of the

topographic file. The appropriate spot elevations, contours and breaklines necessary to create the ttn files will be used. The ttn files will set up so that they can be used with INROADS to create contours at their exact locations.

Most of the project mapping applications at Blue Beach and Red Beach have been produced in AutoCAD and associated applications. The U.S. Navy will specify which applications will be used for the mapping and contouring applications in each project task order.

Each sheet will be standard metric A-1 size drawing (33.1 x 23.4 inches). Each sheet will include a standard border, revision block, title block, complete index sheet layout, bar scale, legend, grid minutes and seconds, and shall be plotted at the horizontal scale required.

The cell library, digital data, and all other supporting files or data will be provided. Production work files will be documented, tabulated and described in the data manual. The manual will include the necessary information for a third party to recreate the products. The manual will be included as a "readme.txt" file with all distributed digital data.

Digital data will comply with and be compatible with U.S. Navy requirements.

5.2.2 Digital Format

All data will conform to the Tri-Spatial Data Standards (TSDS) or CADD/GIS Technology Center Spatial Data Standards (SDS) and as outlined in the specific task order. Any and all deviations from these standards will be done only at the request of the U.S. Navy.

All location survey data and digital maps are transportable and can be copied to portable media for archiving or transfer to other team members. Available formats include CD (the preferred method), digital tape, or 3.5-inch floppy diskettes. The media used is dictated in part by the size of the files. All survey coordinates will be stored as part of the site-wide relational database.

5.3 Deliverables

The following deliverable items and data will be obtained from the surveyor as part of this task order:

- Field Survey – Original copies of field books, layout sheets, computation sheets, and computer printouts. These items will be suitably bound, marked, and packaged for delivery.
- Location Survey Points – Tabulated list of all surveyed control points showing the adjusted coordinates and elevations that were established for the specific OE project.
- OE/MEC Inventory – Tabular list of all OE/MEC components with associated locations and descriptions.
- All survey coordinates and OE/MEC-related digital information will be stored as part of the site-wide relational database. These digital data will be backed up on the same schedule as the site-wide database.
- All unique items created or used to generate deliverables, as requested in each task order.
- Drawings and Data – All maps and associated data will be provided.

SECTION 6

Quality Control Plan

This QCP details the approach, methods, and operational procedures to be employed to perform QC during the Preliminary OE/MEC Investigation of Blue Beach and Red Beach on Vieques Island, Puerto Rico. This QCP, and the requirements and systems established herein, are relevant and applicable to project work performed by CH2M HILL and its subcontractors and suppliers.

This plan was developed in accordance with OPNAVINST 8020.14, *Department of the Navy Explosives Safety Program*, and NAVSEA OP 5 Volume 1, *Ammunition and Explosives Ashore: Safety Regulations for Handling, Storing, Production, Renovation, and Shipping*.

While most of the QC program is directed toward problem prevention, certain elements of the program are associated with correcting deficiencies, should they occur. The primary tools for problem prevention on this project include implementation of QC procedures for calibrations and testing, personnel qualification and training, and submittal and report management. Should these preventive measures fail, tracking and communicating deficiencies provides a mechanism for preventing their recurrence. Each aspect of the QCP is presented in the following subsections.

6.1 Quality Control Procedures for Calibration and Testing

QC calibrations and testing will be conducted routinely during field activities at Blue Beach and Red Beach to ensure that operations are performed according to the performance standards for this project. QC procedures to be implemented include the following:

- Daily pre- and post-operation instrument calibrations and maintenance will be performed to ensure that instrument readings are within manufacturer's specifications.
- Geophysical detection equipment will be tested daily on the site-specific test plot.
- Calibration of navigational equipment will be conducted twice daily by acquisition of survey benchmark locations.
- Target reacquisition accuracy testing will be conducted by repetitive acquisition of selected anomalies.
- Post-operation equipment checks will be conducted to ensure that equipment is serviceable, with damaged or malfunctioning gear identified.
- Independent review of raw and processed data will be conducted by OE/MEC QC Analysts.
- All anomaly validation sheets will be reviewed by two qualified geophysicists prior to intrusive activity.

- Anomaly validation results will be reviewed by the Site Geophysicist to ensure that anomalies correspond to the selected targets. The size, depth, and orientation of each target will be compared with digital data identifying possible discrepancies. All suspect results will be reinvestigated.
- The results of the QC inspections, both passing and failing, will be recorded in the QC log. For any grid that fails a QC inspection, the grid will be completely reworked and QC procedures will be conducted again before submitting the grid for QA inspection.
- Records of these activities are to be generated by the individual performing the activity, with copies provided to the UXOQCS for retention in the project QC file.
- Feedback procedures to capture lessons learned will be implemented, and daily "lessons-learned" components will be incorporated into daily morning safety tailgate briefings.
- After each anomaly validation is completed, the field crew will collect a target signature over the anomaly area in an "X" pattern. The crossing profiles will be at least 20 ft long and will be collected in the north-south/east-west directions. This post-anomaly validation data will be supplied to the Site Geophysicist for review. The purpose of this data collection is to validate and verify that after the validation was completed, no additional anomaly associated with an additional target existed at the excavation location.
- The raw and processed geophysical survey data, replicate and other QC data, field notes, data processing parameters, maps, and anomaly lists will be provided by the geophysical subcontractor to the Project Geophysicist or his designee for QC review.
- QC audits will be performed at the discretion of the CH2M HILL QC Supervisor to ensure that the overall QC procedures and objectives of the project are met.

6.2 Personnel Qualifications and Training

Qualified personnel are considered key to the successful and safe execution of this project. Overall QC for the project will be the responsibility of the UXOQCS. OE/MEC avoidance and removal will be conducted by qualified OE/MEC personnel. Descriptions of the responsibilities and training requirements for the UXOQCS and OE/MEC personnel are discussed in the following subsections.

6.2.1 OE/MEC Quality Control Specialist

The UXOQCS has authority to enforce the procedures defined in this QCP. In alignment with this authority, the UXOQCS has the authority to stop work to ensure that project activities comply with specifications of this QCP, the contract, and the Task Order. This authority applies equally to all project activities, whether performed by CH2M HILL or its subcontractors and suppliers.

The UXOQCS is responsible for planning and executing QC oversight of project operations, and ensuring compliance with specified QC requirements. Specifically, the UXOQCS is responsible for:

1) Developing, assessing the effectiveness of, and maintaining this QCP and related procedures

2) Reviewing and approving the qualifications of proposed technical staff and subcontractors

3) Planning and ensuring the performance of preparatory, initial, follow-up, and completion inspections for each definable feature of work

4) Identifying quality problems and verifying that appropriate corrective actions are implemented

5) Ensuring that the requisite QC records including submittals are generated and retained as prescribed in this QCP

The UXOQCS will have a safety observer present when digging anomalies found during QA inspections, and may act as the safety observer if he elects to have the contractor dig anomalies found during QA inspections. A safety observer is not required if the QA inspection only involves surface inspection or magnetometer sweeps to locate anomalies, provided contractor personnel are in visual observation of the UXOQCS during the QA inspection.

6.2.2 UXO Personnel

Project staff will be qualified to perform their assigned jobs in accordance with terms outlined by the DDESB-approved "UXO Personnel Training and Experience Hierarchy." UXO personnel, assigned to positions UXO Technician I, UXO Technician II, UXO Technician III, UXOSO, UXOQCS, and SUXOS, will be U.S. citizens and graduates of one of the following schools or courses:

- U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD
- U.S. Naval EOD School, Indian Head, MD
- EOD Assistants Course, Redstone Arsenal, AL
- EOD Assistants Course, Eglin Air Force Base, FL
- DoD-certified equivalent course

EOD experience in National Guard or Reserve Units will be based on the actual documented time spent on active duty, not on the total time of service. Additionally, UXO staff from NSRR may be required to work on this project. Active duty NSRR EOD personnel will be called to remove OE/MEC if such items are found during the investigation.

6.2.2.1 Senior UXO Supervisor

The SUXOS will be a graduate of either the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, or the U.S. Naval EOD School, Indian Head, MD. This individual will have at least 15 years of UXO experience, which may be a combination of active duty military EOD and contractor UXO experience, and will include 10 years in supervisory positions. A SUXOS must be able to fully perform all of the functions enumerated for UXO Sweep Personnel and UXO Technicians I, II, and III. In addition, the SUXOS is required to be able to perform the following functions:

- Planning, coordinating, and supervising all contractor onsite OE/MEC activities; preparation of SOPs for OE/MEC operations
- Ensuring compliance with DoD directives as well as local, state, and federal statues and codes
- Certification of AEDA and range scrap as ready for turn-in or disposal in accordance with current policies

The SUXOS must also be fully capable of supervising multiple project teams which may be performing OE/MEC and OE/MEC-related activities such as vegetation clearance; land surveying; reconnaissance and classification of OE/MEC, pyrotechnic items, and military explosives and demolition materials; locating surface and subsurface OE/MEC; destroying OE and MEC by burning or detonation; and transporting and storing OE/MEC and explosives material.

No more than one SUXOS will be present on an OE/MEC project without prior approval of the Navy EOD Contracting Officer.

6.2.2.2 UXO Safety Officer

The UXOSO will have the same minimum qualifications as a UXO Technician III. In addition, this individual will have the specific training, knowledge, and experience necessary to implement the SSHP and verify compliance with applicable safety and health requirements. This individual must be able to perform all functions enumerated for OE/MEC Sweep Personnel and UXO Technicians I, II, and III. In addition, the UXOSO must be able to:

- Implement the approved OE/MEC and explosives safety program in compliance with all DoD, federal, state, and local statutes and codes
- Analyze OE/MEC and explosives operational risks, hazards, and safety requirements
- Establish and ensure compliance with all site specific safety requirements for OE/MEC and explosives operations
- Enforce personnel limits and safety exclusion zones for OE/MEC clearance operations, OE/MEC and explosives transportation, storage, and destruction; conduct safety inspections to ensure compliance with OE/MEC and explosives safety codes
- Operate and maintain air monitoring equipment as required for airborne contaminants

The UXOSO may be dual-hatted with the UXOQCS to perform this function. The UXOSO will not be involved in any OE/MEC removal or investigation tasks. The UXOSO will be hired directly by and work for the prime contractor, and will report directly to the project manager or someone higher in the contractor's organization.

6.2.2.3 UXO Quality Control Specialist

The UXOQCS will have the same minimum qualifications as a UXO Technician III. In addition, this individual will have documented QC Training. This individual must be able to fully perform all functions enumerated for OE/MEC Sweep Personnel and UXO

Technicians I, II, and III. This individual must have the specific training, knowledge, and experience necessary to fully implement the contractor's QC plans. In addition, the UXOQCS must be able to:

- Implement the OE/MEC-specific sections of the QC Program for all OE-related evolutions
- Conduct QC inspections of all OE/MEC and explosives operations for compliance with established procedures
- Direct and approve all corrective actions to ensure that all OE/MEC-related work complies with contractual requirements

A UXOQCS may not be required full-time onsite. QC functions will be performed, however, for all field activities. The UXOQCS will ensure high quality in the field without compromising safety. The UXOQCS will not perform any removal or investigative tasks. The UXOQCS will be hired directly by and work for the prime contractor and must report directly to the project manager or someone higher in the contractor's organization.

6.2.2.4 UXO Technician III

A UXO Technician III will be a graduate of either the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, or the U.S. Naval EOD School, Indian Head, MD. This individual will have experience in OE clearance operations and supervising personnel, and will have at least 10 years combined active duty military EOD and contractor OE/MEC experience. This individual must be able to fully perform all functions enumerated for OE/MEC Sweep Personnel, and UXO Technicians I and II. In addition, the UXO Technician III must be able to perform the following functions:

- Supervising and performing onsite disposal of OE/MEC; preparing explosives storage plans in accordance with all applicable guidance
- Preparing required OE/MEC administrative reports
- Preparing SOPs for onsite OE/MEC operations
- Performing risk hazard analyses; conducting daily site safety briefings
- Supervising the conduct of all onsite evolutions directly related to OE/MEC operations.

6.2.2.5 UXO Technician II

A UXO Technician II will be a graduate of either the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, or the U.S. Naval EOD School, Indian Head, MD. As an exception, a UXO Technician II may be a UXO Technician I with at least 5 years combined military EOD and contractor OE/MEC experience. This individual must be able to fully perform all functions enumerated for UXO Sweep Personnel and UXO Technician I. In addition, the UXO Technician II must be able to perform the following functions:

- Properly storing OE/MEC material in accordance with applicable guidance
- Identifying fuzes and determining fuze condition
- Determining a magnetic azimuth using current navigational/locating equipment

- Performing field expedient identification procedures to identify explosives contaminated soil; preparing an onsite holding area for OE material
- Operating modes of transportation for transporting OE/MEC material, when appropriate.

6.2.2.6 UXO Technician I

A UXO Technician I will be a graduate of one of the courses listed in Section 6.2.2. A UXO Technician I can advance to the UXO Technician II category after 5 years combined active duty military EOD and contractor UXO experience. This individual assists fully qualified personnel (UXO Technician II and above) in the following functions:

- Conducting reconnaissance and classification of OE and other MEC materials
- Identifying all munitions including bombs and bomb fuzes, guided missiles, projectiles and projectiles fuzes, rockets and rocket fuzes, land mines and associated components, pyrotechnics items, military explosives and demolition materials, grenades and grenade fuzes, and submunitions
- Locating subsurface OE/MEC using military and civilian magnetometers and related equipment
- Performing excavation procedures on subsurface OE/MEC
- Locating surface OE/MEC by visual means
- Transporting OE/MEC and demolition materials
- Preparing firing systems, both electric and non-electric, for destruction operations
- Operating Personnel Decontamination Stations (PDS)
- Inspecting salvaged OE/MEC-related material and erection of UXO related protective works; and donning and doffing PPE.

The UXO Technician I *will not* determine whether OE/MEC items are safe to move.

6.2.2.7 UXO Sweep Personnel

UXO Sweep Personnel assist UXO technicians and supervisory personnel in the clearance of UXO, operating only under the direct supervision of qualified UXO technicians or UXO supervisors. This position requires site-specific and job-specific contractor training (which may include ordnance recognition, safety precautions, donning and doffing PPE, etc.) but does not require UXO technician qualifications. UXO Sweep Personnel conduct visual or instrumented OE/MEC search activities in the field; perform field maintenance on military and civilian magnetometers; operate ordnance detection instruments and other similar equipment to include DGM instruments; and remove OE/MEC scrap after such items have been certified/verified safe for handling by a qualified OE/MEC technician. OE/MEC sweep personnel *will not* be involved in the execution of explosives operations, and *will not* excavate anomalies nor handle OE/MEC.

6.2.2.8 UXO Team Composition and Roles

Each UXO team will consist of one UXO Technician III and one to six team members. Teams will have a minimum of two UXO-qualified personnel, one of which will be the UXO Technician III.

A UXO Technician III will supervise all OE/MEC operations and all teams operating within the exclusion zone. These may include brush clearing teams, geophysical teams, UXO Sweep Personnel teams, and laborer teams.

6.2.3 Documentation of Qualification and Training

The review and verification of personnel qualifications will be documented. The UXOQCS will maintain records documenting the required qualifications and training for each site worker. The UXOQCS will monitor expiration dates to provide advance warning to the project manager of when employees will require refresher training or other requirements. The UXOQCS will maintain records of site-specific and routine training for personnel and visitors, as required by this work plan. These records will be maintained on site for audit purposes.

6.3 Submittal and Report Management

The Project Manager is responsible for overall management and control of project submittals, submittal scheduling, and tracking. The Project Manager will establish and maintain an onsite project file in accordance with contract requirements and CH2M HILL policies for document control. The Project Manager is responsible for controlling access to the project file to ensure that records are not lost or misplaced. The purpose of this file is to maintain a complete set of all documents, reports, certifications, and other records that provide information on project plans, contract agreements, and project activities. The initial file will be structured to include record copies of the following documents:

- Schedule and progress reports
- Technical specifications, including addenda and modifications thereof
- Change orders and other contract modifications
- Engineer Field Orders
- Manufacturer's certificates
- Daily work activity summary reports, which may include:
  - Daily QC report
  - Daily Health and Safety Report
  - Daily Superintendent Report (including activity log)
  - Reports on any emergency response actions
  - Test records
  - Records of site work
  - Chain-of-custody records
  - Reports on any spill incidents
  - Truck load tickets and shipping papers
  - Laboratory results
- Other items as required by the Contracting Officer Representative:
  - Conversation logs
  - Meeting minutes and agenda

- Inspection logs and schedules
- Photo documentation
- Site maps
- As-built drawings

As the project activities progress, the Project Manager will monitor usefulness of the project filing system for information retrieval. If he finds that additional file sections are needed, he will expand this initial filing structure to include additional sections.

6.4 Deficiency Management

This section includes provisions for preventing quality problems and facilitating process improvements, as well as for identifying, documenting, and tracking deficiencies until corrective action has been verified.

6.4.1 Continual Improvement

Project staff at all levels are to be encouraged to provide recommendations for improvements in established work processes and techniques. The intent is to identify activities that are compliant but can be performed in a more efficient or cost-effective manner. Typical quality improvement recommendations include identifying an existing practice that should be improved (e.g., a bottleneck in production) or recommending an alternative practice that provides a benefit without compromising prescribed standards of quality. Project staff are to bring their recommendations to the attention of project management or the QC staff through verbal or written means. Deviations from established protocols are not to be implemented, however, without prior written approval by the Project Manager and concurrence of the UXOQCS. Where a staff-initiated recommendation results in a tangible benefit to the project, public acknowledgment is to be given by the Project Manager.

6.4.2 Deficiency Identification and Resolution

While deficiency identification and resolution occurs primarily at the operational level, QC inspections provide a backup mechanism to address problems that either are not identified or cannot be resolved at the operational level. Through implementation of the inspection program prescribed in this QCP, the QC staff is responsible for verifying that deficiencies are identified, documented as prescribed herein, and corrected in a timely manner. Deficiencies identified by the QC staff are to be corrected by the operational staff and documented by the QC staff.

6.4.3 Type I Corrective Action Request

In the interest of timeliness of corrective actions, a Type I Corrective Action Request (CAR) can be issued by any member of the project staff, including CH2M HILL and subcontractor employees. If the individual issuing the CAR is also responsible for correcting the problem, then he should do so and should document the results on Part B of the CAR. Otherwise, the CAR should be forwarded to the Project Manager, who is then responsible for evaluating the validity of the request, formulating a resolution and prevention strategy, assigning personnel and resources, and specifying and enforcing a schedule for corrective actions.

Once a corrective action has been completed, the CAR and supporting information are to be forwarded to the UXOQCS for closure.

Sufficient information is to be provided to allow the QC reviewer to verify the effectiveness of the corrective actions. If the QC reviewer determines that further action is required, then a Type II CAR is to be issued and tracked by the UXOQCS or his designee until resolution.

In addition to observing actual work operations, Type I CARs are to be reviewed during follow-up QC inspections. The purposes of this review are: to ensure that established protocols are implemented properly; to verify that corrective action commitments are met; to ensure that corrective actions are effective in resolving problems; to identify trends within and among similar work units; and to facilitate system root cause analysis of larger problems. Particular attention is to be given by the QC staff to work units that generate either an unusually large or unusually small number of Type I CARs.

6.4.4 Type II Corrective Action Request

Type II CARs are to be issued and tracked by the QC staff for major deficiencies identified during QC inspections and for problems not resolved through implementation of a Type I CAR. In response to each Type II CAR, a written Corrective Action Plan (CAP) is to be developed by a Project Manager designee and approved and signed by the Project Manager. The CAP is to indicate whether it is submitted for informational purposes or for review and approval. In either event, operational staff are to be encouraged to discuss corrective action strategy with the QC staff throughout the process.

6.4.5 Deficiency and Corrective Action Tracking

Each Type I CAR is to be given a unique identification number and tracked by the appropriate line manager until corrective actions have been taken and documented in Part B of the form, and the CAR is submitted to the UXOQCS or his designee for verification and closure.

Each Type II CAR is to be assigned a unique and sequential number by a member of the QC staff and entered on the Type II Deficiency Tracking Log. Deficiency tracking logs are to be reviewed periodically by the UXOQCS to verify that corrective action commitments are met. The UXOQCS has full stop work authority for unresolved deficiencies. The UXOQCS is also responsible for establishing and maintaining a CAR database to facilitate trend analysis and prioritize prevention initiatives.

6.4.6 Documentation

The lessons learned through the deficiency management process are documented on CARs and CAPs. To share the lessons learned with the government, these documents are submitted to the government through the Daily QC Report.

Type I CARs should be cited in the Daily QC Report. Minor deficiencies that are identified during a QC inspection but can be readily corrected and verified in the field are to be documented in the QC log and Daily QC Report without initiating a CAR. Deficiencies identified in a QC inspection but that cannot be readily corrected are to be documented by the QC staff on a Type II CAR and in the Daily QC Report. Copies of Type II CARs are to be referenced in and attached to the Daily QC Report.

Where a Type II CAR has been issued, a written CAP is to be prepared under the direction and approval of the Project Manager. Type II CARs are to indicate whether the CAP also requires QC approval before implementation. CAPs will be attached to Daily QC Reports to document the final outcome of the deficiency. Similar or related deficiencies may be addressed on a single CAP.

SECTION 7

Environmental Protection Plan

7.1 Endangered/Threatened Species Within the Project Site

Table 7-1 lists the federally protected plant and animal species that are known to occur or that have the potential to occur on Vieques.

TABLE 7-1
Federally Listed Species Occurring or Potentially Occurring at Vieques

Scientific Name (Common Name)	Federal Status
Plants	
Chaemacrista glandulosa var. mirabilis (Herb)	Endangered
Stahlia monosperma (Cobana negra)	Threatened
Calyptranthes thomasiana (Tree)	Endangered
Eugenia woodburyana (Evergreen tree)	Endangered
Reptiles and Amphibians	
Chelonia mydas (Green sea turtle)	Threatened
Dermochelys coriacea (Leatherback sea turtle)	Endangered
Eretmochelys imbricata (Hawksbill sea turtle)	Endangered
Birds	
Falco peregrinus tundrius (Arctic peregrine)	Threatened
Pelecanus occidentalis occidentalis (Brown pelican)	Endangered
Sterna dougalli dougalli (Roseate tern)	Endangered
Mammals	
Physeter macrocephalus (Sperm whale)	Endangered
Balaenoptera physalus (Fin whale)	Endangered
Megaptera novaeangliae (Humpback whale)	Endangered
Trichechas manatus (West Indian manatee)	Endangered

Source: GeoMarine, 2000

Of the four federally protected plant species listed in Table 7-1, the only plant species expected to have the potential to occur within or in the vicinity of the project area is the Cobana negra tree (*Stahlia monosperma*). The Cobana negra is a federally threatened tree that has been reported to occur in the transition zone between black mangrove *(Avicennia germinans*) communities, salt flats, and upland communities at Vieques. Based on the habitat preference of this species, this tree may occur within the proposed project area. However, the proposed work will not require tree removal, nor will it involve activities that would harm trees. No vegetation removal will be required for geophysical surveys. Therefore, this species is not expected to be impacted by the project. All project personnel will be given instructions prior to initiation of work to avoid contact with any specimen of the Cobana negra tree that is found within the project area.

All of the federally protected sea turtle species listed in Table 7-1 have the potential to utilize the marine environment near Red Beach and Blue Beach and also the beach shorelines during nesting. Sea turtle nesting may occur from March through November. Because the proposed work will not extend seaward of the shoreline, none of the work activities will impact the marine environment. The proposed survey activities will occur along the shoreline. Therefore, all project personnel will be instructed to avoid any sea turtles or sea turtle nests that are encountered. All sea turtle nests that are located will be marked by flagging during the duration of the project to prevent potential impacts. All sea turtle tracks sighted within the project area will be reported to the Project Manager and Natural Resources Program Manager at NSRR.

All of the federally protected bird species listed in Table 7-1 have the potential to utilize the project area for foraging, particularly the brown pelican and roseate tern. None of these bird species are expected to use the project area for nesting; therefore, their potential presence would be transitory. Because of the nature of the proposed work, no impacts to these bird species are expected. All of the federally protected marine mammal species listed in Table 7-1 have the potential to occur in the marine environment near Red Beach and Blue Beach. Because the proposed work does not extend seaward of the shoreline, none of the work activities will impact these or other marine species.

7.2 Wetlands Within the Project Site

Based on available aerial photography, no wetlands appear to be located within the project area. However, small wetlands that are undetectable on aerial photography may exist. Because of the nature of the proposed work, no onsite wetlands are expected to be impacted by the project.

7.3 Cultural and Archaeological Resources Within the Project Site

Based on available data, the probability that significant cultural or archaeological resources are located within the project area appears to be low. Because of the nature of the proposed work, any cultural or archaeological resources that may exist within the project area are not expected to be impacted. If any cultural or archaeological material or resource is discovered

within the project area, a qualified archaeologist will be notified of the site and the archeologist will provide guidance on performing further work in the area.

7.4 Water Resources Within the Project Site

Based on available aerial photography, no water resources appear to be located within the project area, except for the Caribbean Sea to the south of the project area. Because of the nature of the proposed work, no water resources are expected to be impacted by the project.

7.5 Coastal Zones Within the Project Site

The entire southern side of the project area is a coastal zone (Caribbean Sea). No work is proposed seaward of the mean high tide boundary along the coastline. Because of the nature of the proposed work, the marine environment seaward of the shoreline and the areas landward of the shoreline are not expected to be impacted by the project.

7.6 Trees and Shrubs That Will Be Removed Within the Project Site

The proposed work will not involve removal of any trees or shrubs within or outside of the project area.

7.7 Existing Waste Disposal Sites Within the Project Site

Based on available data, no waste disposal sites are located within or in the immediate vicinity of the project area. The nearest waste disposal site is Solid Waste Management Unit (SWMU) 1, an inactive landfill located approximately 1,000 ft north of the project area. The proposed work will not affect nor be affected by SWMU 1 or any other waste disposal site.

7.8 Compliance with ARARS

CH2M HILL will follow all applicable regulations and obtain all necessary permits concerning environmental protection, pollution control, and abatement necessary for the proposed project work. Table 7-2 lists the applicable regulations and requirements for environmental protection. Other Applicable or Relevant and Appropriate Requirements (ARARs) to be followed were presented in Table 1-1.

TABLE 7-2
Potentially Applicable or Relevant and Appropriate Requirements for Environmental Protection
NASD, Vieques Island, Puerto Rico

Reference	Title
Federal Requirements	
16 USC 1531 et seq., per 50 CFR 402	Endangered Species Act
16 USC 703, et seq.	Migratory Bird Treaty Act
16 USC 469, et seq., and 36 CFR 65	National Archaeological and Historic Preservation Act

Note:
CFR = Code of Federal Regulations

7.9 Detail Procedures and Methods to Protect and/or Mitigate the Resources/Sites Identified

Prior to initiation of the proposed work, a general survey of the project area will be conducted by a qualified ecologist to identify any obvious environmental concerns. The ecologist, in conjunction with the Project Manager, will provide instructions to field personnel regarding the protection of onsite environmental resources. Such protective measures will include, but are not limited to, the following:

- Avoid contact with any specimen of the Cobana negra tree or any other federally protected plant that is found within the project area. Mark specimens within the project area with flagging for easy identification.
- Avoid any sea turtles or sea turtle nests that are encountered. All sea turtle nests that are located will be marked by flagging during the duration of the project to prevent potential impacts. All sea turtle tracks sighted within the project area will be reported to the Project Manager and ecological supervisor at NSRR.
- Any UXO found within or near a wetland will be identified and removed without impacts to wetland soil, vegetation, or hydrology.
- If any cultural or archaeological material / resource is discovered within the project area, a qualified archaeologist will be notified to provide guidance on performing further work in the area.
- Any UXO found in the immediate vicinity of a water body will be identified and removed without impacts to the water resource.
- Any UXO found near the coastal zone will be identified and removed without impacts to the coastal environment.
- The Project Manager will seek the guidance of the qualified ecologist to determine appropriate mitigation measures in the event that the performed work activities result in impacts to any environmental resource.

SECTION 8

Geographical Information System Plan

This Geographical Information System (GIS) Plan describes the incorporation of GIS into the data management phases of OE anomaly validation actions at Blue Beach and Red Beach. This plan was developed in accordance with OE MCX DID OE -005-14.

The comprehensive OE-GIS and associated database will be established to track and manage the data generated during the course of OE/MEC anomaly investigations and the disposition of OE/MEC-related scrap and detonated OE/MEC. The hardware and software tools to be used have been chosen specifically to provide a flexible system that allows effective and timely data management, long-term storage and archiving of data, and expansion of the database to include new information that can readily be integrated into the existing database as appropriate. The database and GIS are also designed to be transportable to existing project applications developed and maintained by other members of the Vieques project team. This will provide an efficient mechanism for retrieving OE/MEC-related information for technical evaluation, removal efforts, reporting, and ultimately to assist in the efficient transfer and reuse of parcels at Vieques.

The data will be managed using the CADD/GIS Technology Center SDS as outlined in SDS/FMS release 1.95 where applicable. The intent of these SDS is to provide data in an accessible and predictable format that can be used by standard, readily available GIS software applications.

8.1 Geographical Information System Incorporation

The purpose of this task is to leverage GIS technology to effectively manage and integrate OE-related data collected as part of the ongoing investigations being conducted at Vieques. When properly set up, GIS applications can integrate spatial data (maps) with tabulated data stored in databases (such as OE and MEC type, location, and status).

Significant amounts of background and location data collected during the various investigations that have been conducted or are currently being conducted are already integrated into a GIS for the site. The intent of this GIS is to leverage existing systems that have already been developed for the Navy so that the GIS can be integrated to meet the needs of OE/MEC investigations and ultimately assist in decision-making regarding future reuse of parcels.

Based on the research and direction of the Navy, a comprehensive database, Arc/INFO, ArcView OE-GIS will be developed to manage, evaluate, and report site information. The OE-GIS system will be based on the current environmental system for Vieques and will incorporate additional data for OE/MEC investigation, ordnance tracking, reporting, and decision support systems. Where applicable, additional data such as geology, hydrogeology, and infrastructure will be incorporated to assist in the investigation. Attribute data are stored in a relational database that is inherently linked to the spatial data through the GIS

interface. Spatial data identifying elements such as buildings are managed in Arc/INFO and ArcView. The Arc/INFO and ArcView GIS is integrated with the database and used to perform spatial analyses of the various attribute and spatial data. All existing data is currently referenced to the 1983 NAD 83, UTM coordinate system.

Widely used, commercially available hardware and software will be utilized in the development and maintenance of the OE/MEC database and GIS. No proprietary software will be used to prepare these applications. Tools developed for interim analysis will be documented and may be evaluated by the Navy. This ensures that data will be readily accessible by all members of the project team authorized to use these data. This also ensures that the data is portable should it be necessary to transfer the GIS and associated database to other servers and workstations.

A computer system will be available onsite (at Vieques) for GIS data entry, management, and reporting. The Contractor will provide GIS and database support on an as-needed basis to assist with GIS system functionality and use.

The existing Vieques GIS has been developed in the ArcView GIS environment. ArcView GIS will be the primary GIS software for all GIS data management and mapping. The Microsoft Office 97 suite of programs (including Microsoft Access, Microsoft Word, Microsoft Project, and Microsoft Excel) and AutoCAD (Release 14 or 2000) will also be used on this project, where applicable.

The data collected during the anomaly validation study will be made compatible with the GIS platform utilized by the U.S. Army Engineering Support Center, Huntsville (USAESCH), the Ordnance and Explosive Mandatory Center of Expertise (OE-MCX). CH2M HILL will establish a MicroStation 95 data file that parallels the system used by Huntsville. All OE-related files, geophysical survey data, analysis grids, and intrusive data will be made available in a format that is compatible with USAESCH format. These may include (but are not limited to) ArcView shapefiles, Microstation .DGN files, comma delimited ASCII data files, dBase (.DBF) format files, or Access databases, depending on the specific needs of the deliverable.

Microsoft Access 97 will be the primary database software used to manage OE/MEC data. The database will include a database schema, electronic data entry functions, QA/QC reporting audits of the data, data management, and a link to the spatial data supporting the site-wide GIS. The site-wide relational database will be stored in Microsoft Access 97 at this time. These database tables and relationships will be compatible for transfer of the data to an Oracle platform in the future if requested by the Navy.

All field data collected, as part of the removal actions will be managed in and integrated with the site-wide relational database. The data fields in field forms and field data collection equipment will be formatted to be consistent with the data fields used in the database. Anomaly data will be collected using a real-time data collection process that will generate a raw data file consisting of values for easting, northing, and magnetometer value. Naming conventions will be developed so that all field observations and measurements are consistent. Attributes specific to the OE/MEC investigation will be stored and managed in tables separate from other database tables (such as environmental or endangered species related data). Several types of information that will be used to join tables include:

- Site name - Common name used to identify the study area
- OE Parcel – Site number assigned to each study area
- Grid number - Unique number of sampling grid where UXO was observed
- Identification number - Unique identification number assigned by the field team to each observation, UXO or OE component, or explosion pit

OE / MEC spatial data will be entered into the database as point data identified by a unique northing and easting coordinate pair (a unique point designator will also be assigned). In the event that multiple OE / MEC items encountered in the field are grouped and classified as a cluster, the cluster location will be entered into the GIS as a single point. A field in the OE / MEC point attribute table will identify such clusters. A separate table with unique OE / MEC item records will be developed (and linked to the point location layer) that will be used to track the item through the project life cycle. Attribute data will be related to the OE / MEC point layer to provide a detailed description of the cluster as appropriate.

OE / MEC item attribute data include both qualitative and quantitative sample information such as ordnance type, quantity, and status. In addition, a munitions database (provided by USACE) can be linked to the OE / MEC item table to provide physical, chemical, and explosive data regarding each OE or MEC item found in the field. This anomaly validation study will not require the use of various USACE models for evaluation buried explosives, trajectory, and other assessments related to the unintentional detonation of munitions. If required (as a result of field conditions), this analysis will be scoped in a separate task.

The workflow for transferring the field data to the database is summarized as follows.

1. Field observations are recorded either on pre-defined field forms or electronically (laptop / palmtop system). Electronic data collection systems will have predefined data dictionaries with drop-down boxes to simplify and standardize recording of field data.

2. Data from the geophysical survey will be processed by the field team leader daily, and the processed files will be submitted to the project data manager for QA and incorporation into the standard data management structure. Each file will be stored in original format and converted to the standard GIS or database format to be included in the system.

3. At the end of the field day, data on field forms are verified for completeness and accuracy (i.e., number of observations made match the number of observations recorded). Copies of the field forms are made and hard copies of the electronic forms are printed for the field office.

4. Data from field forms are entered into OE database loading tables (either onsite or transmitted to a local office for data entry). These tables are then loaded into the OE GIS and database. Electronic forms are processed onsite and loaded directly into the OE database.

5. QC checks of the data will be based on a set of reports that will be generated from the database and provided to the project manager and field team leader for review. For example, the ordnance type information cannot be entered unless an ordnance sampling location has been properly defined.

6. After data tables are loaded, the database is ready for use at the site for data analysis and reporting, uploading to the onsite GIS, generation of field maps, or transfer and uploading to the Vieques site-wide database.

When required for field data collection, data entry fields on the paper and electronic forms will match the field names in the OE/MEC database. This will allow the project team to track the flow of OE/MEC information from data collection through processing, analysis, storage, and archival.

The OE/MEC database will also be used to store and track inventory information related to the anomaly investigation. If OE/MEC is moved and detonated onsite, this information will also be included in the GIS/database system.

Additional data will be incorporated as necessary into the onsite GIS as layers. These layers consist of pre-existing data, or other non-OE/MEC data collected during the OE/MEC investigation. Sources for such data include existing CAD files, published data, and output from other software applications. Examples of these layers include existing anomaly data, and spatial and attribute data collected and mapped by previous investigators, if available.

The GIS will not be used to store all raw data generated during the OE and MEC investigations. For example, data points collected by geophysical instruments, gridded data used by modeling programs to generate contour maps, and similar types of backup data will likely be archived as separate tables in the database or as independent databases. An attribute field will be added to the GIS coverage that identifies a file location or similar reference to document these data. The interpreted results of analysis (such as interpreted geophysical results), however, will be included in the GIS.

8.2 Computer Files

All data, text, and digital maps will be available in standard file formats. Text will be delivered in either Microsoft Word 97 or Adobe Acrobat Portable Document Format (PDF), as requested in the specific project task order. The shareware PDF viewer will be provided along with the PDF documents.

All GIS and associated database and digitized aerial photographs are transportable and can be copied to portable media for archiving or transfer to other team members. Available formats include CD-ROM (the preferred method), digital tape, or 3.5-inch floppy diskettes. The media used is dictated in part by the sizes of the files. All survey coordinates will be stored as part of the site-wide relational database.

SECTION 9

References

A.T. Kearney, Inc. and K.W. Brown & Associates, Inc. *Phase II RCRA Facility Assessment of the Naval Ammunition Facility, Vieques Island, Puerto Rico*. October 1988.

CH2M HILL. *Final Master Ordnance and Explosives (OE) Master Work Plan, Former U.S. Naval Ammunition Support Detachment, Vieques Island, Puerto Rico.* October 2001.

GeoMarine, Inc. *Biological Assessment for Continuing Training Activities on the Inner Range, Vieques, Puerto Rico.* Atlantic Division, Naval Facilities Engineering Command, Norfolk, Virginia. 2000.

Greenleaf / Telesca Planners, Engineers, Architects, Inc., and Ecology and Environment, Inc. *Initial Assessment Study*. *Naval Station Roosevelt Roads, Puerto Rico*. September, 1984.

USAESCH. HQDA LTR 385-98-1, *Explosives Safety Policy for Real Property Containing Conventional Ordnance and Explosives.* 1998.

USAESCH. IGD 00-03, *Basic Safety Concepts and Considerations for Ordnance and Explosives Operations.* 2000.

APPENDIX A

Response to Comments

NOSSA Comments
Preliminary OE/MEC Site Investigation Work Plan for Blue Beach and Red Beach
Eastern Maneuver Area
Vieques Island, Puerto Rico
October 2002

1. Comment: Page 1-1, 1st paragraph, 6th line; Change "munitions of explosive concern" to "munitions and explosives of concern"

Rational: Correct terminology

RESPONSE:
Munitions of explosive concern has been changed to "munitions and explosives of concern".

2. Comment: Page 1-2, Section 1.1, 1st paragraph, last sentence: "The LIA will be managed in the short term as a wilderness area." The preceding sentence excluded the LIA from transfer until a later time. Does this mean the Navy will manage the LIA as a wilderness area?

RESPONSE:
All of east Vieques will be transferred to the DOI. DOI will manage the LIA as a wilderness area and the remaining eastern lands as a wildlife refuge. The first paragraph has been changed to read as follows:

"On May 1, 2003, the U.S. Navy's presence on the eastern end of Vieques will come to a close as Naval operations at the facility cease in accordance with current legislation (Public Law 106-398-Appendix). The current legislation calls for the property on the eastern end of Vieques including the AFWTF and the EMA to be transferred to the Department of the Interior (DOI) and to be managed as a federal wildlife refuge by the Fish and Wildlife Service (FWS). The Live Impact Area (LIA) will also be transferred to DOI and will be managed as a Wilderness Area with no public access."

3. Comment: Page 1-2, Section 1.2, 1st paragraph, last sentence: Should indicate what the "intended purpose" is. Do we mean recreational use? Also, once these beaches have been assessed and reopened for recreational use, they can no longer be used for military operations involving any type of ordnance. This situation must be clearly made to affected units.

RESPONSE:
The following has been added to the first paragraph of section 1.2:

"The intended land use of Blue and Red Beaches is public recreation. Once the beaches have been cleared and reopened for recreational use, they will no longer be used for military operations involving any type of ordnance."

NOSSA Comments
Preliminary OE/MEC Site Investigation Work Plan for Blue Beach and Red Beach
Eastern Maneuver Area
Vieques Island, Puerto Rico
October 2002

4. Comment: Page 1-2, Section 1.2, 2nd paragraph: Delete reference to AR 385-64 and HQDA LTR 385-98-1.

Rational: These Army documents are not applicable on Navy owned property. NAVSEA OP 5 is the Navy version of AR 385-64.

RESPONSE:
Army references have been deleted from section 1.2.

5. Comment: Page 1-5, Table 1-1: Change "Environmental Pollution Agency" to "Environmental Protection Agency".

RESPONSE:
The EPA name has been corrected.

6. Comment: Page 2-1, Section 2.1.1: Add "DoD 4145.26-M, DoD Contractor's Safety Manual for Ammunition and Explosives."

Rational: This is a major document and as such, it should be listed.

RESPONSE:
DoD 4145.26-M, DoD Contractor's Safety Manual for Ammunition and Explosives has been added to section 2.1.1.

7. Comment: Page 2-3, Section 2.1.2: Add a new bullet – "The Project Manager shall immediately notify the Commanding Officer of NAVSTA Roosevelt Roads upon discovery of chemical warfare material."

Rational: While it is unlikely that any chemical warfare material will be found, should this event occur, the CO of NAVSTA RR must be informed immediately due to the potentially severe hazard presented by the CWM. The notification may be given by the CH2M HILL Project Superintendent or other person having sufficient detail knowledge but not directly involved in response actions.

RESPONSE:
A bullet stating "In the unlikely event that chemical warfare materials are identified, the Project Manager shall immediately notify the Commanding Officer of Naval Station Roosevelt Roads upon discovery of chemical warfare material" has been added to section 2.1.2.

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8. Comment: Page 2-6, 4th paragraph, 2nd sentence: AFWTF and EMA should be replaced with Red Beach and Blue Beach. This comment applies throughout the document.

Rational: Because this is a site-specific work plan, i.e. Red and Blue Beaches, the document should clearly and consistently indicate such.

RESPONSE:
AFWTF and EMA has been replaced throughout the document with "Red Beach and Blue Beach" where appropriate.

9. Comment: Figure 2-2: There should be a dotted line between NOSSA and the CH2M HILL Project Manager denoting document review/clarification.

Rational: On past efforts at Vieques Island, NOSSA has provided comments on documents as well as procedural clarification directly to CH2M HILL as directed by NAVFAC LANTDIV.

RESPONSE:
A dotted line has been added to Figure 2-2 between NOSSA and the CH2M HILL Project Manager.

10. Comment: Page 2-10, 5th(?) paragraph and page 2-12, 2nd paragraph: Change "USA EOD team" to "USA UXO team".

Rational: The term EOD is normally used for military service personnel involved with UXO. As it currently reads, one would believe that the United States Army EOD personnel are involved rather than non-military, contractor personnel as is the actual situation.

RESPONSE:
USA EOD team has been changed to USA UXO team on pages 2-10 and 2-12.

11. Comment: Page 2-10, last paragraph and page 2-12, 2nd paragraph: delete "NOSSA will be notified"

Rational: There is no requirement that NOSSA be involved in the decision process. Post notification is sufficient.

RESPONSE:

The notification of NOSSA has been deleted on pages 2-10 and 2-12.

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12. Comment: Figure 2-3: Delete box "Notify NOSSA".

Rational: see rational for comment #11.

RESPONSE:
The box labeled Notify NOSSA has been deleted from Figure 2-3.

13. Comment: Page 2-10, 5th paragraph: Change "refer to section 2.1.3.2.2" to "refer to section 2.1.3.2.3"

Rational: Believe reference section is incorrectly identified.

RESPONSE:
Refer to section 2.1.3.2.2 has been changed to 2.1.3.2.3 on page 2-10.

14. Comment: Page 2-12, last paragraph: Delete "If NOSSA ..... will continue".

Rational: There is no requirement that NOSSA be involved in the decision process.

RESPONSE:
NOSSA has been deleted from the last paragraph on page 2-12.

15. Comment: Page 2-22, 2nd and 3rd paragraphs: Reconcile the apparent discrepancies between the two paragraphs regarding depth, i.e. 1 foot versus 2 feet.

RESPONSE:
The depths should both be one foot and have been corrected.

16. Comment: Page 2-25: Add new bullet – "Operations will stopped and secured 30 minutes prior to sunset".

Rational: MEC operations are inherently dangerous. Conducting them in poor lighting conditions when unnecessary adds an unacceptable risk to this project.

RESPONSE:
A bullet has been added to page 2-25 stating " Operations will be stopped and secured 30 minutes prior to sunset".

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17. Comment: Page 3-2, Section 3.3.4: Need to add words to describe the use of Red and Blue Beaches.

RESPONSE:
The following text has been added to section 3.3.4: "Red Beach and Blue Beach were used for amphibious assault training exercises. Only small arms blank cartridges were used and possibly photo-flash cartridges."

18. Comment: Page 3-15, Section 3.5.4, last bullet: Add " If the equipment fails to perform correctly during the end-of-day check, the area surveyed by that piece of equipment must be re-surveyed."

Rational: The equipment failure voids the detection results from that piece of equipment.

RESPONSE:
The following text was added to the last bullet in section 3.5.4: "If the equipment fails to perform correctly during the end-of-day check, the area surveyed by that piece of equipment must be re-surveyed."

19. Comment: Pages 3-19 Section 3-10 and 3-21 Section 3-11: Both sections provide non-site specific information/requirements and acknowledge that, in addition, there may be site specific requirements. Where are the site-specific requirements?

RESPONSE:
The site specific requirements will be determined after the geophysical prove-out is conducted and the geophysical instrument is selected. The QC requirements for various geophysical instruments are included in the Master Work Plan.

20. Comment: Page 4-5: Add hazards of chain saws and any other equipment used for brush removal.

RESPONSE:
Hazards of chain saws and other brush removal equipment have been added to section 4.3.

21. Comment: Page 4-32: Why the note under Medical Emergency that states there will be a call back within 20 minutes? There should always be a qualified person answering a medical emergency phone number.

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RESPONSE:
The phone number you refer to is for Dr. Peter Greaney, who is the CH2M HILL medical consultant. For medical emergencies, the field team would call the local 911 number. For CH2M HILL medical emergencies there is also a 24-hour emergency beeper number listed twice on the table.

APPENDIX B

List of Revisions

TO BE DEVELOPED FOR FINAL WORK PLAN SUBMISSION